ACORN USER

BBC micro, Electron and Atom magazine

March 1984 £1

generation 2

generation 3

generation 4

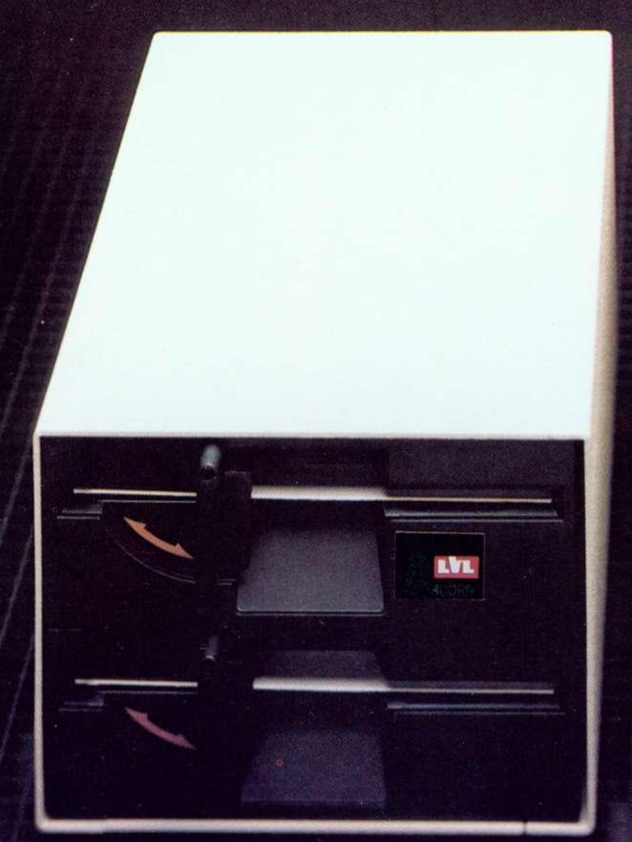
generation 5

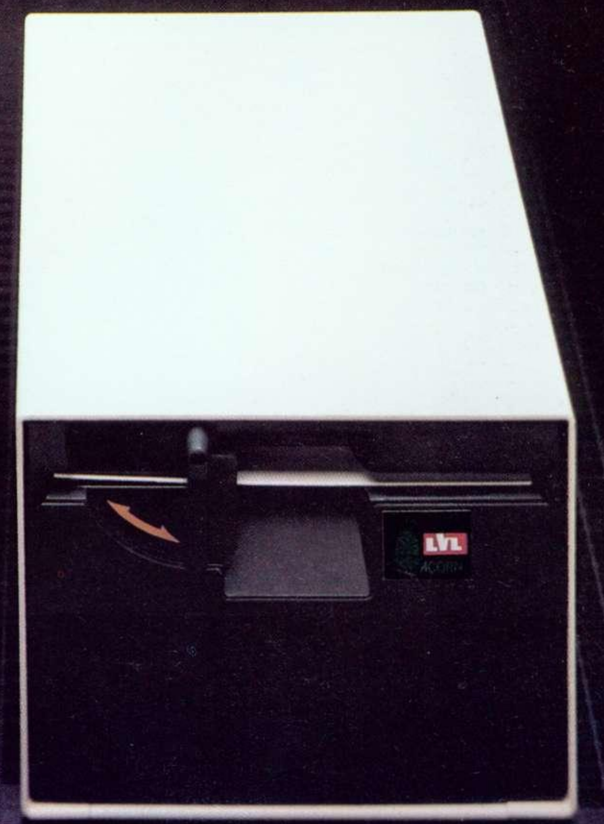
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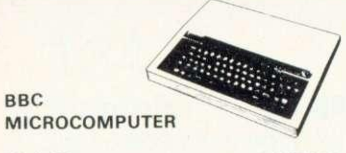
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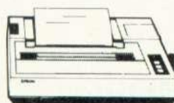
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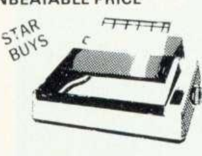
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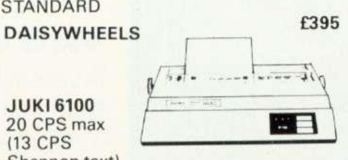
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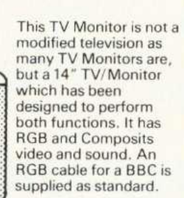
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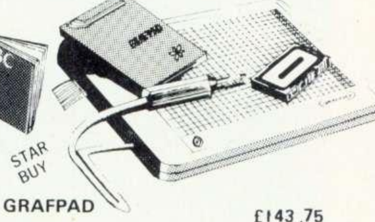
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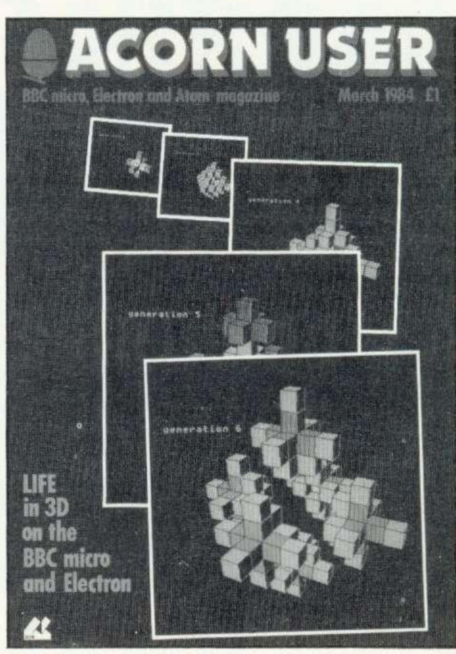


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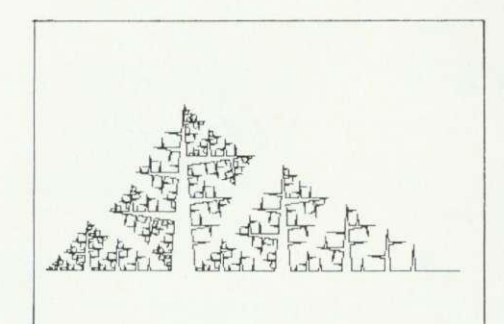
TCL

AU3/84

EMS



Front cover photography and Life article by Malcolm Banthorpe Design by Phil Kanssen



How to submit articles:
You are welcome to send articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written with double line spacing. Black and white photographs or transparencies are also appreciated. If submitting programs a cassette or disc is vital. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere. Send articles, reviews and information to: The Editor, *Acorn User*, 53 Bedford Square, London WC1B 3DZ. Tel: 01-631 1636.

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Fancy graphics:
Making use of the BBC micro's video controller chip to produce special effects

BBC micro 52k:
Does the Aries B20 RAM board live up to its claims?

BBC TV:
We look behind the scenes at how Beebs are changing television

Schools:
Joe Telford takes a look at software from Acorn's new education arm. It is any good?

April Fool:
Watch out for it in the April issue. Don't say we didn't warn you!

Filing systems:
First of a series on Acorn's Advanced Filing Systems and their structure

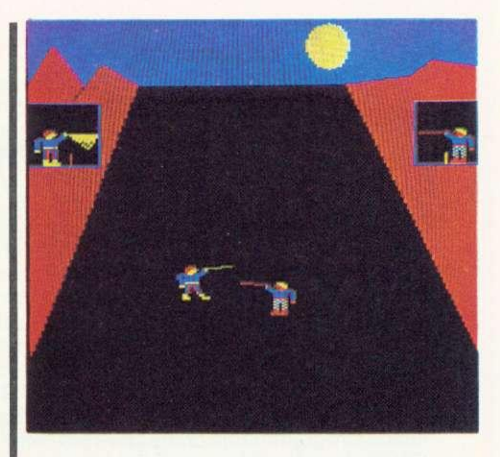
Atom to BBC Basic:
How to convert listings from one Acorn dialect to the other

Authors please note

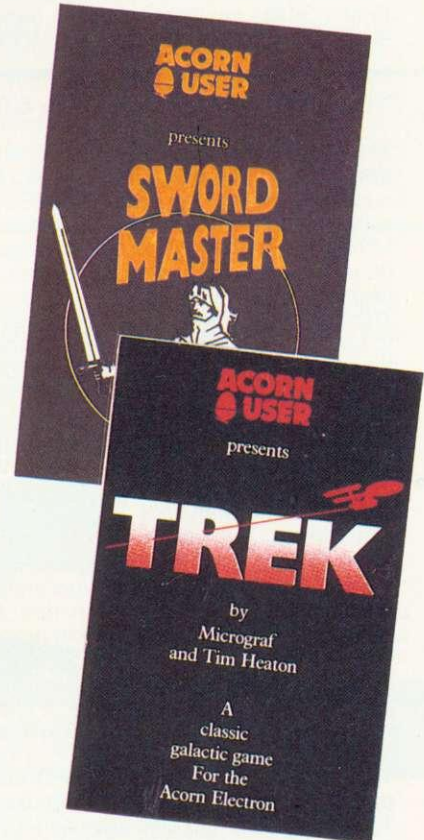
We've been inundated with articles for publication – many of an extremely high standard. It takes time to read them, try listings out and edit them – which is the only way to maintain standards. Also remember that magazines work at least two months in advance.

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TWO games are now available from *Acorn User*. They are Sword Master (BBC B and Electron) and Trek (BBC B and Electron). Both make extensive use of the excellent graphics, speed and sound of the machines. Turn to page 13 for details.

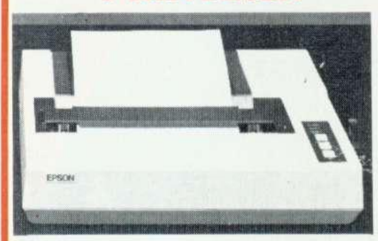
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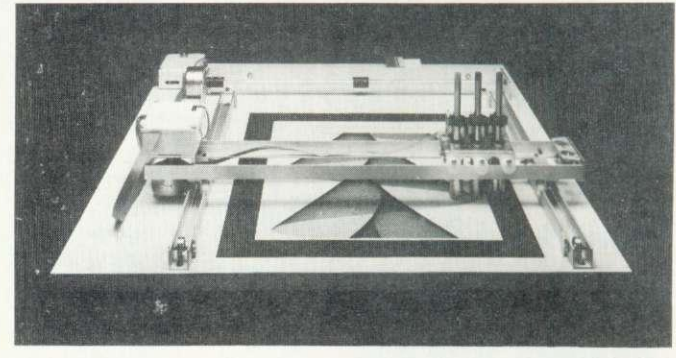
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TECHNOMATIC

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BBC only (at present): Demon Decorator £6.95/ Galactic Commander £7.95/Time Trek £7.95/ Asteroid Storm £7.95/Laser Command £7.95/ Alien Swirl £6.95/Labyrinths of LaCoshe £7.95/ Filer £9.95/Cowboy Shootout £6.95/Wall £5.95/ Chemistry £6.95/Beebmon £7.95/Barrage £7.95/ Adventure £7.95/Caveman Adventure £6,95/ Danger! UXB £7.95/World Geography £6.95/ Where? £6.95/Junior Maths Pack £6.95/ Constellation £6.95/Physics £6.95.
BBC MICRO AND ELECTRON PROGRAMS CAN BE OBTAINED FROM SELECTED BRANCHES OF W H SMITH, JOHN MENZIES, BOOTS, HARRODS, ALL GOOD DEALERS, OR DIRECT FROM MICRO POWER.

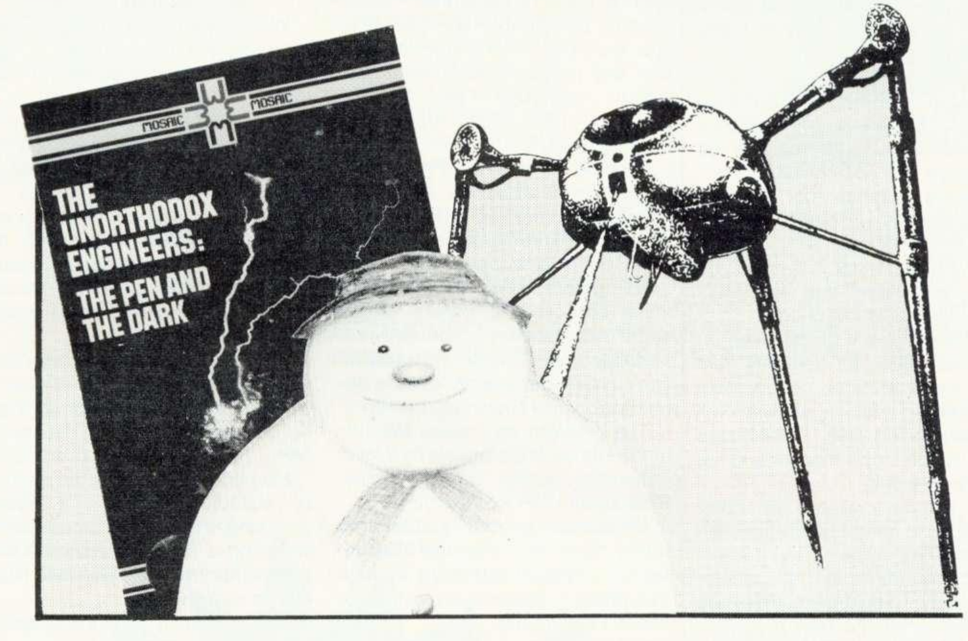
Software revolution

THE War of the Worlds should soon be appearing on your micro – and it's just the start of a string of well-known books which could bring about a revolution in software marketing.

Many of the projects are still under wraps, as publishers try to keep their plans away from the prying eyes of competitors, but other targets we can reveal include *The Snowman* and *Fungus the Bogeyman* by Raymond Briggs and a deal with Desmond Morris.

One publisher refused to talk about the contracts he was negotiating, but said they would have a 'shattering' effect on the industry.

And it's not only the best-seller league which is snatched up: some publishers are packaging software with lesser-known titles, or with books yet to be released. The combination of cassette or disc with a book has spawned the name 'bookware'.



War of the Worlds, science fiction, The Snowman – all sources of software ideas

Two pieces of bookware for the BBC micro which are already selling at £9.95 include *The Pen and the Dark* and *My Secret File*. The first is a science fiction story by Colin Kapp sold with a text adventure game, and the second is a popular Puffin paperback packaged with a personal database. Children can fill in the program and book with secrets about themselves and other people, and the software includes a secret code known only to the owner.

Vicky Kahn, one of the brains behind Mosaic, who publish these two titles, said demand had been much higher than expected from the book trade and that another print run had to be ordered.

She is now working on a bookware scheme for young children based on books by Desmond Morris.

And Century are about to release *Legend*, a piece of Tolkein-like fantasy fiction, in April. This will be followed later in the year by a version of the book with cassette and full-colour map of the kingdom in which the tale takes place.

A spokesman explained that the book was probably not vital to play the game, but that it established the setting and characters as well as their relationships.

The same is true for the Mosaic titles.

Century took their book to a professional games designer, and then took the game to a programmer; in fact several programmers for the different micros.

'This entailed a heavy investment,' said the Century man. 'It's painful but necessary. We've got a good game – not just a quick way of collecting money for Christmas.

'We plan to recoup our outlay by putting the game onto several machines, and each new one as it comes along.' So far versions are planned for the BBC, Commofore 64 and Sinclair's QL.

The H. G. Wells software is being developed by Jeff Wayne – former producer of pop star David Essex who did the *War of the Worlds* album six years ago – and software-house CRL. It will be the first piece of software CRL have put out for the Beeb, but Clement Chambers, the man behind the company, is determined the project will succeed.

'It's going to be something special, based on the record rather than directly on the book,' he explained. 'This story has been a smash hit in all the media – as a book, radio, film and record – and I'm not going to go down in history as the man who messed it up.'

Meanwhile, Quicksilva should have already released the *Snowman* package, which takes elements from the Raymond Briggs book to use as an arcade game, (although for the moment it's only on the Spectrum).

Mark Eyles of Quicksilva described the program as 'enchanting.' He added: 'It had to be carefully done and fits in with the flavour of the book. We didn't want to detract from the original, so it's a non-violent game.

'The idea is to build up and then dress the snowman, and then get objects for him to play with.

'We've tried to make the screen characters as near to the originals as possible, within the limitations of the machine.'

The advent of bookware is creating work for literary agents who traditionally handle writers. Jacqui Lyons now has games designers and machine code programmers on her books, and is negotiating software rights for books and TV programmes.

'It's incredibly refreshing, because we're opening up a whole new area and there's a lot of material lying around. The major problem seems to be the "generation gap." The people who make the decisions and have the power in the media have no concept of the computer explosion — and some feel frightened by it.'

So how much do the computer rights for a bestseller cost? Well, nobody's saying. They are obviously much cheaper than film rights, although few will take any bets as to how long this will last.

As one publisher said: 'At the moment the cost of computer rights bears no resemblance to film rights, but this time next year I could be eating my words.'

Way to beat the tape pirates

SO WHY the sudden interest in books combined with software? It seems to be explained by a combination of factors. One is that the books provide a wealth of ideas which just need to be dusted off. One of the problems with the software industry is its lack of imagination: most programs are just rehashes of pub games or old favourites.

Next, publishers themselves want to get in on an expanding market. Their expertise is in books; the books have the ideas and then it's a matter of translating the idea into a program—and enough competent software writers and computer whizz-kids are now available to do the work.

Most programmers are still paid by royalties for that work, but they are more likely to be brought on to the staff or paid as normal freelances.

Third is the old chestnut of tape copying. It's virtually impossible to prevent this, but if there's a book, map, board or other printed material which has to be photocopied, it makes piracy less worthwhile. If this trend continues, the tendency towards fancy protection systems should fall off, ending the problem of upgrading to discs.

Fourth is the obvious publicity and promotion factor. Software has already become just another spin-off from the movie industry in the US, in the same way as tee-shirts, or Star Wars model kits. People are creatures of habit, and if their children already have Mr Men colouring books, why not Mr Men software? Or for that matter, Minder, James Bond, Noddy and The Far Pavilions!

Atom software from Pickles

ATOM users will need no reminding that software support is fast diminishing – even Acornsoft packs being difficult to obtain.

However, the cavalry is riding to the rescue, in the form of Software Classics, launching on February 29(!) with a catalogue of over 60 titles, some old, some new.

Software Classics has acquired the acclaimed Program Power range and negotiations are in progress with Acornsoft. Titles include games, educational and small business programs at low prices.

All cassettes will be supplied on Sony C60 tapes, for reliability, and will carry a lifetime replacement guarantee. In addition, software will be available on disc. ROM-based items include a new monitor and the Atom Screen chip.

The company is run by Barry Pickles (who needs no introduction to *Acorn User* readers), and it seeks to become the main source for Atom users. Would-be authors are welcome to submit new programs for marketing.

A catalogue is available by sending a large sae to: Software Classics, 2 Connie St, Openshaw, Manchester M11 2JD.

PCW Show move

THE PCW Show, taking place this year from September 19-24, will be held at Olympia 2 in London.

The new venue opens just a few weeks before Show and the organisers reckon the move means an end to overcrowding at the Barbican.

The PCW Show is organised by Montbuild Ltd, 11 Manchester Square, London W1.

Lost authors

IN THE chaos of Christmas, we've lost two addresses. This is a plea for Stuart Menges and Andy Mitchell to get in touch!

Edword for the Welsh

COMPUTER languages have long been a bone of contention: Basic, Pascal, Comal and the rest. But now the spoken language is at issue, with pressure coming from the Welsh (although the Gaelic, prounced 'garlic', Scots are, as yet, keeping quiet).

In some parts of the Principality, English is learned as a second language, something to be acquired when the children first start school.

It's definitely a case of Welsh first and English second. And this is why there are growing moves to get some of the primary school software translated into Welsh so children can understand exactly what is appearing on their classroom monitors.

The problem was raised recently in the House of Commons by Welsh nationalist leader, Dafydd Wigley, Plaid Cymru MP for Caernarfon.

He wanted to know just what is being done to meet the requirements of Welsh speakers through the present Microelectronics Education Programme.

The answer, it appears, is a bit. . . but not much.

Welsh education minister John Stradling Thomas was left to fend off most of the parliamentary probes from Mr Wigley.

The question of developing Welsh language software, he explained, was being considered by MEP staff in Wales.

Mr Wigley, who admits to being a home computer buff himself, believes it is important that software is readily available where the screen instructions and responses are in Welsh.

'We are still just at the beginning of using computers in education and it is really a matter of getting it right, right from the start,' claims the MP.

He became aware of the scarcity of suitable software for Welsh speaking schoolchildren while watching a Beeb recently installed at a primary school in his own North Wales constituency.

'It was actually an English-speaking constituent who pointed out how all the programs were in English while in my own village of Bontnewydd over 90 per cent of the families are Welsh-speaking,' he explained.

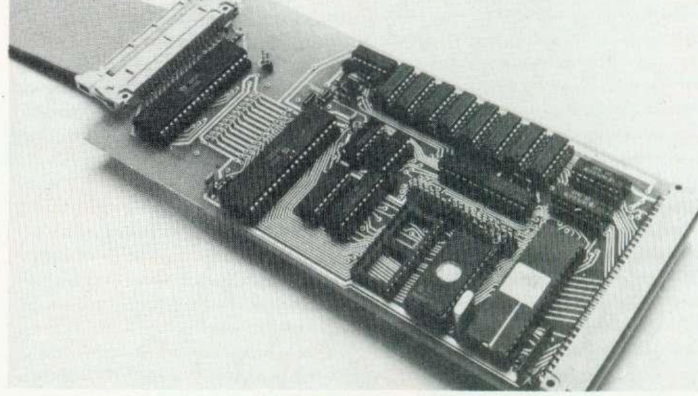
However, a start has been made to beginning translating software. The Welsh Office has provided funds for translating and developing Welsh language computer material, most of it for the BBC micro. This includes translating part of the Edword educational word processor package.

In addition, some local education authorities in North Wales have made a start in writing their own Welsh language software for schools.

Maybe up in Cambridge they should consider a special strip for the front of the micros – the BBC Mesen Cyrrifiadur – in place of the more familiar BBC Acorn Computer.

That at least should ensure they keep a Welcome Tape – sorry, Tâp Creso – on the hillside.

6809 board will run Flex DOS



6809 second processor from CMS uses Tube interface

ENGINEERS developing hardware now have the option of using a 6809 second processor which connects to the BBC micro's Tube interface. It can sit inside the computer's casing, or outside in a Eurocard system if any expansion is needed.

The board, made by Cambridge Microprocessor Systems, uses Flex, an 8k disc operating system, with the BBC. This supports a range of languages such as PL9, C, BCPL, Pascal, Fortran, Forth and Cobol.

CMS sees the second processor being used for professional hardware development, and in colleges and universities for its ability to develop software for other eight-bit microprocessors (eg Z80, 6502, 8080, etc) when used with cross-assemblers.

A compatible 6809 single board controller is available for linking to applications hardware.

The processor with Tube interface costs £249 (+VAT) with cables and software extra. CMS, 11 St Margarets Rd, Girton, Cambridge CB3 0LT.

PUBLISHER'S ANNOUNCEMENT

THE publishing rights of *Acorn User* will be handed over from Addison-Wesley Publishers Ltd to the Redwood Publishing Company after the April issue.

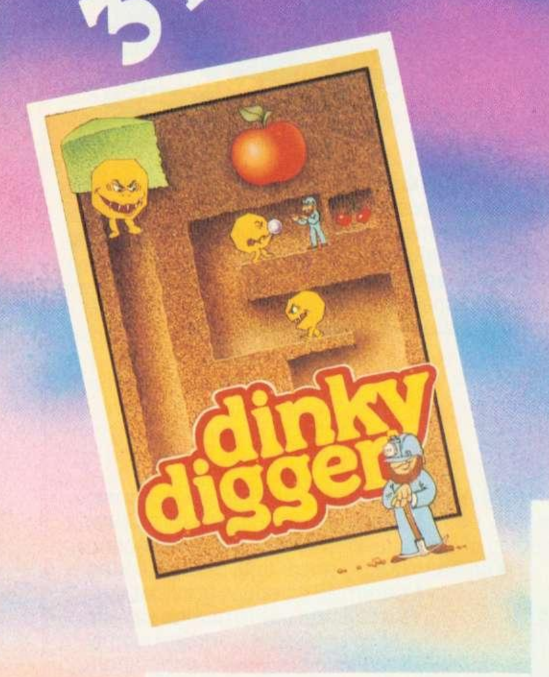
The new owners intend to continue to expand both the size and the editorial coverage of *Acorn User*. The magazine will be available as usual and all subscriptions will be serviced as normal. All advertising commitments will be honoured.

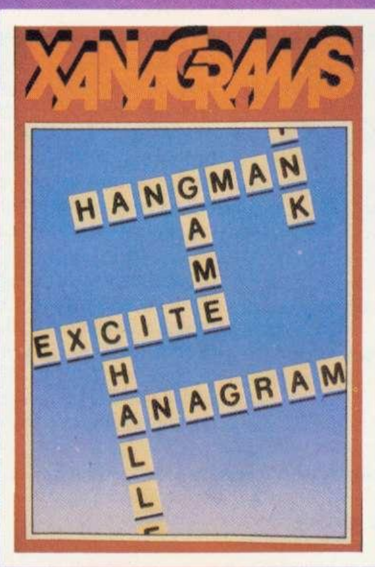
So, it's business as usual, except for a new editorial address: *Acorn User*, Redwood Publishing Company Limited, 68 Longacre, London WC2. Tel: 01 836 2441. Articles, products for review and any enquiries should be sent to this address.

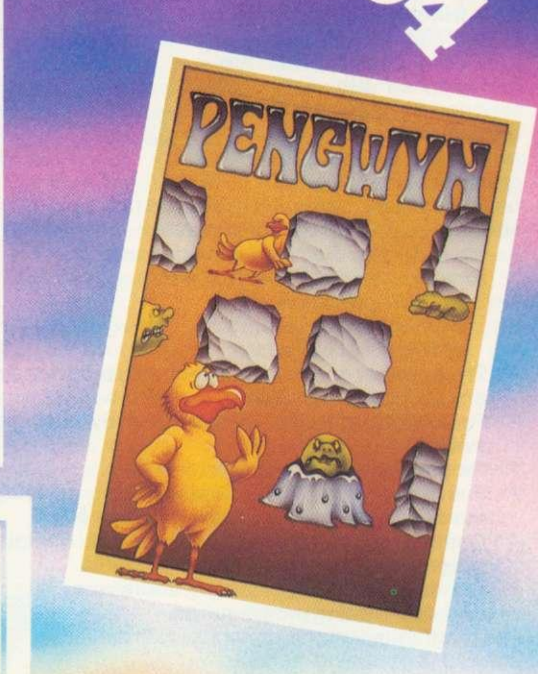
Any enquiries concerning advertising should be sent to the advertising agents: Computer Marketplace Ltd, 20 Orange St, London WC2H 7ED. Tel: 01 930 1612.

Addison-Wesley would like to thank readers for their support over the past 20 months in helping to make *Acorn User* the successful magazine it is, and Redwood looks forward to continuing the relationship.

3 from POSTERN for '84







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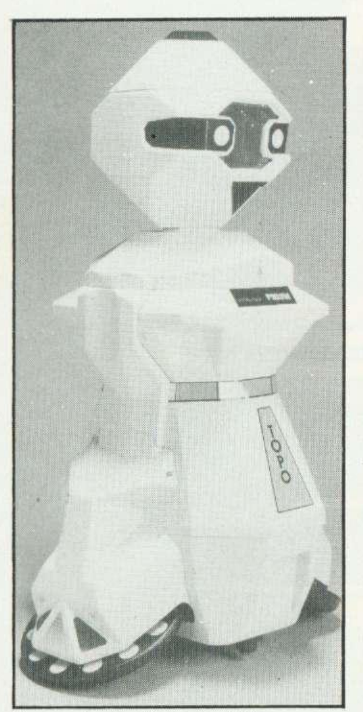
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Please Postern People post me:

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Price £6.95 each

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Topo: domestic gimmick

Robots meet micros

ROBOTS are about to start taking over, judging by the numbers now appearing.

First, there were simple turtles for schools, then along came the more sophisticated BBC Buggy. Now we have the 'Androbots' – FRED and Topo.

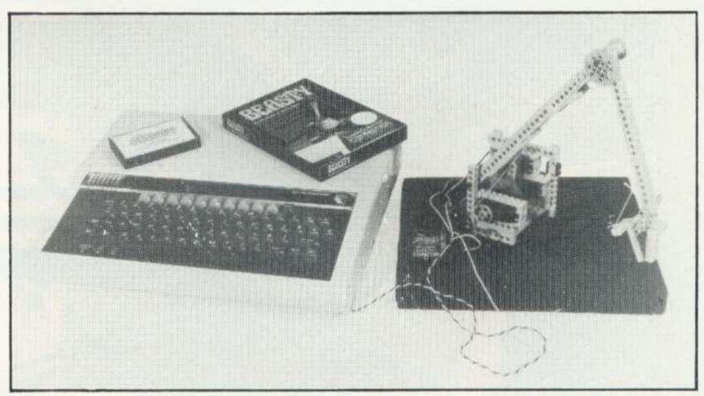
FRED, who boasts the full title Friendly Robotic Educational Device, is really a glorified turtle with infra-red control.

Topo is claimed to be the first personal robot and the 'ultimate peripheral to a personal computer' by its distributors Prism.

Both robots are made in the US and controlled by joystick or micro. They can 'walk' and 'talk'.

Prism sees these as the first in a family of Androbots whose future tasks include mowing the lawn, vacuuming, fetching and carrying – and even detecting intruders.

FRED will set you back about £200 and Topo about £1500.



Beasty links Beeb to servo devices on crane

But competition is around in the shape of Hero, which Maplin claims is the world's best-selling training robot.

Again, Hero will interface to the BBC micro by wire, infra-red or radio link. Although not as flashy-looking as Topo, Hero has become something of a star with appearances on BBC and ITV.

Maplin, who distribute Hero in the UK, hope to launch a comprehensive course to introduce their robot to schools.

Further plans include speech recognition capability, as well as improved voice quality.

Hero comes in kit form at £1599, and assembled for £2500.

The Beasty is more down to earth compared to the Prism and Maplin offerings.

It's a miniature interface box which can control up to four servo mechanisms on models, industrial equipment and toys through software or directly by commands issued from the Beeb's keyboard.

Our picture above shows the Beasty controlling a crane kit from the micro. The Beasty is the little black box in the middle, not the crane itself.

Commotion, who distribute the Beasty, even market a computerised cat door! The device links to the Beeb's user port.

If you want to splash out on Topo or FRED, Prism are at 18 Mora St, City Rd, London EC1V 8BT.

Hero, the rival for position as man's best electronic friend, comes from PO Box 3, Rayleigh, Essex SS6 8LR.

Commotion's standard Beasty module costs £49.95. Details of this, and its various accessories, from 241 Green St, Enfield EN3 7SJ.

Paper round boon

NEWSPAPER deliveries are the target of Huggler – a BBC micro-based system which takes care of accounting and VAT. So a Beeb could soon be adding up your *Acorn User* bill!

The software is designed to cope with 600 customers, served by a maximum of 20 round with up to 100 customers per round.

Details are held in disc files of customers publications, accounts and standing orders, holidays can automatically be dealt with and round lists printed out at any time.

Twin disc drives, printer, monitor, micro and software cost £1,750, which includes installation and training for the newsagent at his own premises.

The database allows information to be accessed for a particular list, customer or magazine title.

All this can be edited from the micro to ensure prices, addresses and orders are kept up to date.

Huggler is produced by Newsbox, who also run a leasing scheme. The address for details is: 9 Walcot St, Bath BA1 5BN.



Acornsoft launch disc swap

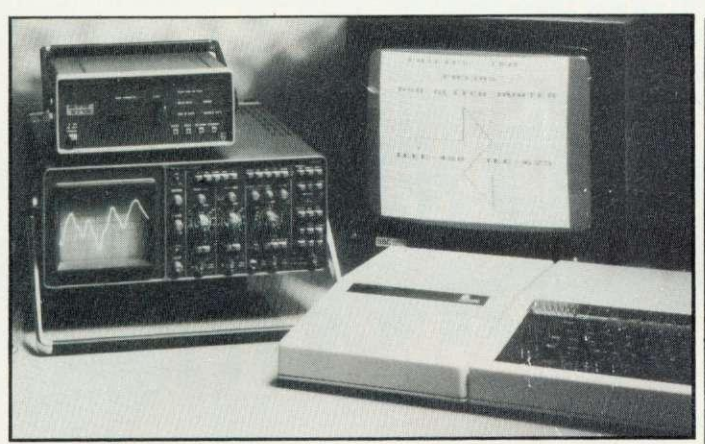
ACORNSOFT will now exchange cassette software for discs at half the price of the disc version.

For example *Starship Command* costs £9.95 on cassette and £11.50 on disc. In exchange for the cassette, the disc may be purchased for £5.75.

The service applies only to Acornsoft products, and customers should return the cassette (without the outer box), enclosing the relevant remittance, to: Disc Replacement Service, Acornsoft Ltd, c/o Vector Marketing, Denington Industrial Estate, Wellingborough, Northants NN8 2RL. Consult the latest Acornsoft catalogue to check availability of programs in 40 or 80 track versions. Acornsoft Limited, 4a Market Hill, Cambridge CB2 3NJ.

IF YOU don't know what this is, we're not going to tell you – yet. If, by some chance, anyone can decode it, there's a piece of software awaiting the first correct answer to reach us by post.


A CAREER AWAITS YOU IN
INTERGALACTIC GEOLOGY!!
Eagle



Acorn's IEEE interface sitting between Beeb and Philips equipment

IEEE is out now!

THE Acorn IEEE interface was launched last month, and Acorn seemed as surprised as any potential users to admit that supplies were available immediately.

The device, says Acorn marketing manager Tom Hohenberg, broadens the appeal of the BBC micro to scientific and educational establishments and offers 'a low-cost means of monitoring scientific instruments, making it a powerful laboratory tool'.

The hardware consists of a box designed to match the BBC micro, self-powered via its own mains cable. The software is supplied in a chip that fits in one of the Beeb's sideways ROM sockets to provide the IEEE operating/filing system. It has its own 1MHz bus connection, enabling it to be linked to other Acorn interfaces, such as Econet and Acorn's teletext adapter.

In effect, the interface acts as a local area network, allowing the model B (1.0 OS) to support up to 14 IEEE 488-compatible devices, which can be connected in a star or linear configuration, with a cable-length limitation of up to 20 metres.

Typical equipment in the network would include oscilloscopes, voltmeters, logic analysers, spectrum analysers, function generators, frequency meters and counter/timers. Data can be sent and received in strings of up to 255 ASCII characters, and longer strings can be transmitted in binary coded form. The interface can instruct two devices to transfer data from one to the other without involving the Beeb's memory, so freeing the micro for other tasks.

Measurements can be handled in a number of ways, for example, readings from a multimeter can be monitored overnight on disc or mainframe, using the micro, say, to log exceptions; the Beeb could control the frequencies on a generator; or store waveforms digitally or manipulate them on an oscilloscope.

The Beeb's eight-mode colour graphics allows data to be displayed in a highly readable form – for example, good results in green, failed results in red and borderline in mauve.

Access to the filing system's commands is provided by the command *IEEE and the system can be used with Basic or assembler programs. PROCINIT can be defined to initialise the interface, PROCOUTPUT to send information across the bus and PROCINPUT to receive data. The user can quickly build a library of bus procedures.

The interface, complete with 70-page user guide, costs £325 (inc VAT), and is available from Acorn dealers or from Vector Marketing.

Further information on the interface is available in Philips Systems Instrumentation Reference Manual and Philips Digital Instruments Course Book Part IV, from Philips Test and Measurement, tel: 0223 358866. Philips can also supply example programs.

Micro modem

SCICON has launched a modem aimed at the micro market. It's called Buzzbox and costs £70.

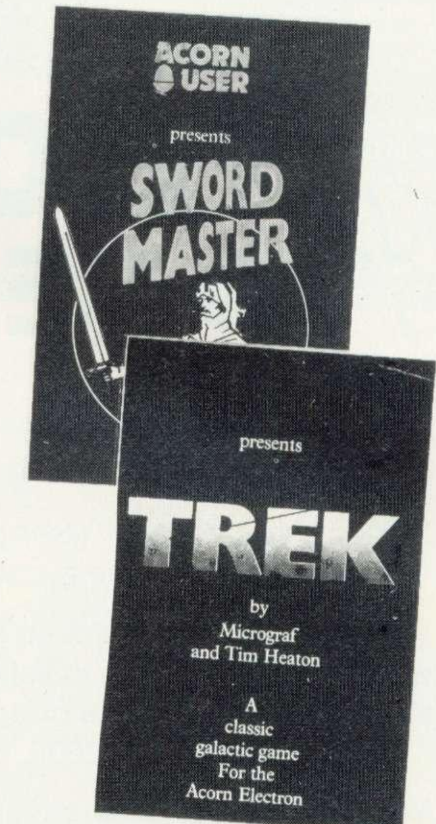
The pocket-sized device gives micros access to databases through the telephone system and means programs can be exchanged over the phone.

Buzzbox gives full 300bps duplex data transmission, and is BT approved.

Scicon is traditionally a 'big computer' company and also supplies more sophisticated intelligent modems. The Buzzbox is the first modem to compete with acoustic couplers on price.

TV adventure

REMEMBER the *Adventure Game* featured in last October's issue? Well, Auntie Beeb has finally started the series. The first episode went out on Thursday February 2 on BBC2 at 5.40pm. The others follow at the same time each week. (Watch out for the special effects produced by BBC micros.)



£7.95 inclusive
for 32k BBC micro
or Electron
(joystick or keyboard)
Two-player game

£7.95 inclusive
for Electron
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(joystick or keyboard)
Uses voice synthesis

Acorn User presents two high-quality games on cassette for your micro which put you at opposite ends of time. Developed, produced and tested by Micrograf.

Sword Master by Ken Worrall is based on the fencing rules written in 1190 by Herman von Salza for the Deutscritter Order of Teutonic Knights. It features full colour, machine code animation of a sword duel between the players shown on screen as knights.

Full instructions, music, sound effects, player rankings (from greenhorn to Swordmaster) and a roll of honour (which can be saved) and all included. The game also closely reflects the rules, style and dress of the Deutscritter Order.

Trek puts you in charge of a Starship with the task of wiping out an alien fleet. It's an excellent adaptation of the classic game with 7 screen displays, 3 on-board computers and 2 weapon systems.

Versions have been written for BBC micro and Electron to use both machines to their full. The BBC tape uses voice synthesis (if the chips are fitted).

The game has been extensively developed from Tim Heaton's Trek III. It now barely fits into 32k – and the graphics are in mode 7.

More tapes will soon be released.

To: **Acorn User Software, 53 Bedford Square, London WC1B 3DZ.**

Please send me:

......copies of **Sword Master** at £7.95 each for BBC (32k Series 1 OS) £ ....

......for Electron £ ....

......copies of **Trek** at £7.95 each for BBC (32k Series 1 OS) £ ....

......for Electron £ ....

I enclose a cheque for £........ made payable to Addison-Wesley Publishers Ltd.

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Write your puzzle in a clear and unambiguous way – and then write a Basic program to solve it. The best puzzle submitted in the opinion of the editor of *Acorn User* and Century Communications Ltd will win £500. Each runner up will receive £5.

Your puzzle may be an old chestnut or it may be completely of your own devising but you must include a Basic program to solve it – preferably on cassette or disc. Try to make it as concise as possible.

Send your puzzles to:

Century/*Acorn User*
Prize Puzzle Competition,
Century Communications Ltd,
12-13 Greek Street, London W1V 5LE.

Rules of entry

1. Any number of entries may be submitted. The closing date of the competition is Tuesday, May 2, 1984.
2. Winners will be informed by post and announced in the pages of *Acorn User*.
3. Copyright in all winning puzzles and Basic programs submitted will belong to Century Communications Ltd and *Acorn User* and may be published both in the magazine and in a book.
4. The decision of the editor of *Acorn User* and Century Communications Ltd is final and no correspondence will be entered into.



FOR THE BBC MICRO

Cumana 5¼ inch slimline dual disk drives for the BBC Micro are now available from well known high street outlets, including W. H. Smith, John Lewis and Spectrum UK, as well as from Cumana's national dealer network.

The dual drives are available in two versions, as shown, including a 'switchable'. This version enables either drive to be switched independently between 40 and 80 track modes.

Each unit has an independent power supply, 12 months warranty, and is fully assembled and tested before packaging. A drive connecting cable, user manual, formatting diskette, power supply lead and plug are all supplied complete with the disk drives.

Look out for the distinctive Cumana packaging in your high street, today!







Cumana Limited, Pines Trading Estate,
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Note: If dealer, please attach this form to your letterheading.



		TITLE	PUBLISHER	TAPE	DISC
1	*(11)*	DR WHO	BBC Soft	£10.00	
2	*(-)*	DARE DEVIL DENNIS	Visions	£ 7.95	
3	*(1)*	3D BOMB ALLEY	Software Invasion	£ 7.95	£11.95
4	*(6)*	TWIN KINGDOM VALLEY	Bug Byte	£ 9.50	
5	*(7)*	KILLER GORILLA*	Program Power	£ 7.95	
6	*(20)*	HUNCHBACK	Superior	£ 7.95	£11.95
7	*(-)*	MISSILE CONTROL	Gemini	£ 9.95	
8	*(-)*	OBLIVION	Bug Byte	£ 9.50	
9	*(-)*	WHITE KNIGHT	BBC Soft	£10.00	
10	*(3)*	THE HOBBIT	Melbourne	£14.95	
11	*(10)*	PLANETOID	Acornsoft	£ 9.95	
12	*(19)*	VORTEX	Software Invasion	£ 7.95	
13	*(-)*	GALAXY WAR	Bug Byte	£ 9.50	
14	*(-)*	FELIX & FRUIT MONSTERS	Program Power	£ 7.95	
15	*(4)*	CHUKKIE EGG	A&F	£ 7.50	
16	*(2)*	3D DEEP SPACE	Postern	£ 7.95	
17	*(-)*	DANGER! UXB	Program Power	£10.00	
18	*(-)*	737 FLIGHT	Salamander	£ 9.95	
19	*(-)*	SNAPPER*	Acornsoft	£ 9.95	
20	*(5)*	747 FLIGHT	Dr Soft	£ 8.95	£11.95

*AVAILABLE ON THE ELECTRON

This chart was compiled from a panel of specialist computer outlets (referenced against both multiple retail and major wholesale data), by RAM/C. It is based on returns from mid-December to mid-January.

WELL, no one can say this software chart is boring – no less than nine new entries, with one having the nerve to come in at number two, and none ever having sat under the 'bubbling under' banner.

Christmas must have a lot to answer for, including the appearance of the dreadful *Doctor Who* at number one. It replaces *3D Bomb Alley*, which has had a two-month reign, but we can't help feeling that this offering from BBC Soft itself was bought *for* computer freaks, rather than by them. Or could it be people have bought *Dr Who* thinking it really is an adventure game?

Now where *Dare Devil Dennis* came from is a real mystery. It was only released just before Christmas, and Visions isn't exactly the biggest name in games. We haven't even seen a review copy, so it must have been the picture we carried of Roz and Digger (the brains and the beauty behind Visions) that did it in our January games issue.

The old-timers among us might well have the cockles of our hearts warmed by the sight of *Snapper* making a bit of running. The Acornsoft favourites are always hanging around, but this might be a sign of Electron sales making an appearance. In the long run, Electron games sales should swamp the chart, at least if the machine is the great success Acorn says it will be, as it will have younger users.

One noticeable absence from the chart is still Virgin. The Virgin Gang now has about 10 titles to play with, but only *Space Adventure*, one of the earliest releases, has even reached the 'bubbling under' stable. Looks like the Fun Bus has a lot more miles to cover.

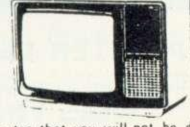
Another surprising factor after three months is the non-appearance of adventure games. Only *The Hobbit* has raised its head from the bubbles, and advance orders from the big chains no doubt explain that. When are the bomb-dropping, alien zapping, trigger-happy vidiots going to catch on to lamp-rubbing, dragon-slaying and dwarf-bopping?

BUBBLING UNDER: *City Defence* (Bug Byte); *Arcadians* (Acornsoft); *Hopper* (Acornsoft); *Rocket Raid* (Acornsoft); *Bandits at Three O'Clock* (Program Power); *Felix in the Factory* (Program Power); *Chess* (Acornsoft).

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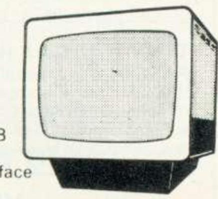
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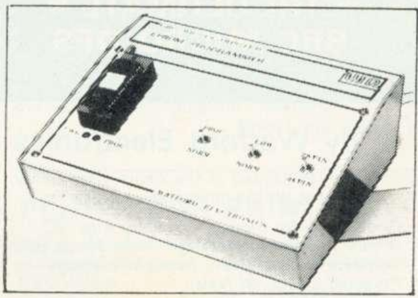
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Without a doubt, the most sophisticated DFS Software yet written for BBC Micro Computer.

This powerful new DFS is fully compatible with ACORN DFS yet has much increased power due to additions, carefully designed to make life easier in normal use. It consists of over 14K of efficiently written machine code. It is entirely self contained and so does not require a utilities disc to function.

• The system can either use the ACORN standard 31 files per disc side or DOUBLE THE CAPACITY to 62 files. The size is selected at formatting time. Copying between discs with different catalogue sizes works perfectly normally.

• A FORMATTING PROGRAM is built in, permitting formatting to 35,40,80 track formats with either 31 or 62 files. Since the formatter is built in to the DFS it can be used without affecting whatever program you are using.

• A DISC VERIFIER is also built in. This checks the internal checksums on each sector to identify any corrupted data. This is extremely useful when saving valuable data as it shows faulty discs quickly and easily. Again it does not affect the program you are using.

• A built in DISC SECTOR EDITOR gives a screen window onto the disc enabling detailed editing of any byte on the disc. This is very useful for recovering accidently deleted files and can save weeks of work.

• A double step mode allows the user of 80 TRACK DRIVES TO READ 40 TRACK DISCS. This mode is software selected for each drive individually, thus allowing a 40 track disc to be copied onto an 80 track one very easily. THIS ELIMINATES THE NEED FOR EXPENSIVE SWITCHABLE DRIVES.

• A WORKFILE function sets the name to be used when the null filename is issued. This allows a program to be edited and repeatedly saved having only typed its name once.

• When using LOAD, CHAIN, etc. it is possible to specify an ambiguous filename. This will result in the first file whose name matches the specification being used. This saves typing the end of a filename that you know is uniquely identified by its first few characters.

• Two commands exist to simplify the transfer of programs from TAPE TO DISC. These load the file to &1100, switch off the disc system and then move the file to its correct load address; thus saving a lot of complicated programming. This command can be used to load files up to 27K75 long.

• An advanced COPY command is included which will prompt the user, requesting whether to copy each file.

• RENAME has been extended to allow the use of ambiguous filenames. This allows you to change BERT1, BERT2, BERT3 to FRED1, FRED2, FRED3 with only one command.

• OPENOUT has been improved to give you fewer annoying 'Can't extend' errors, as it automatically picks the biggest space on the disc in which to put a file. A SPACE command lets you know how much space *COMPACT could create before you waste time doing it.

• 2K of RAM can be reclaimed from the DFS by setting "PAGE" to & 1100.

Now with extra features:

• The powerful library system has been extended so that libraries now work on all accesses not only *RUN. This allows you to have a utility directory with all your commonly used programs without muddling in your current workfiles. Very useful for BCPL User.

• Programs can now reside lower in memory by reclaiming some of the DFS' workspaces, indeed PAGE can be taken as low as £1100 under most circumstances.

• To make DFS easy to use, wild cards ("*") have been made vastly powerful, e.g. *INFO

Continued:

DFS continued:

A gives information on all files in the current directory which have an "A" anywhere at all in their filename.

• Comprehensive and clearly written Manual (available separately) gives the user a complete package deal.

• Fully compatible with BBC TELETEX and TORCH Systems

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BEEBFONT ROM

BEEBFONT is a remarkable new concept in BBC software, exclusively available from Watford. Once fitted, the 16K ROM will enable you to produce attractive text displays in following different styles:

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★ **It works in modes 0, 1, 2, 4, using full colour.**
★ Simply use Ctrl–V to select the font and all further screen output will be in a new style.
★ Even the ordinary Beeb character set can be enhanced by doubling height or width and emphasising to give bold print.
★ A comprehensive editor is included which enables the user to design his own characters.
★ A spooling program is provided which enables pre-formatted text files to be displayed on an Epson printer using the full range of character styles.
★ This really must be one of the most original and exciting products of the year.
★ A twenty page manual is provided and the demo/editor software comes on disc or cassette (please specify when ordering). ONLY **£39**

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A sophisticated Disc Utility ROM with many useful commands. (For detail description please refer to Computer Concept's advert in this magazine.)

Wordwise

Without doubt a very sophisticated piece of software for the BBC Micro. It has all the features of a professional word processor yet is easy to use.

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BEEBMON

The most powerful and versatile machine code monitor ROM yet written for BBC Micro. It has all the normal memory editing, moving and relocating facilities, plus all editing is with a full screen editor allowing scrolling up and down memory, entering in Hex, ASCII or standard assembler mnemonics.
In use as a debugging tool, you run code under a total emulation system. Everfelt a desperate urge to set a break point in ROM? No problem – you can even have breakpoint on reading or writing locations in memory and on register contents. The system fully supports debugging of sideways ROMs e.g. BASIC can fully and easily be run from within Beebmon and from there DFS and other sideways ROMs can be used in total emulation mode.
Beebmon can even run itself. In so doing you can nest Beebmon up to a level limited only by the memory size. Beebmon uses 256 bytes of workspace, located anywhere in memory, even on the 1MHz Bus. Beebmon effectively uses no zero page workspace, so your program (e.g. BASIC) can use any or all of the base page.
How does it achieve this? By providing a 6502 interpreter all programs running under it exist in a vertual BBC, so special memory locations like the ROM latch are not actually accessed by your programs, instead they alter a location in Beebmon's workspace. Emulation also allows immediate return to Beebmon command level by ctrl-escape no matter what code is being excuted at the time. All this exceptional power and flexibility is complemented by a clear and detailed manual included in a value for money price of:

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CRITICAL TIMER

Jonathan Gibbs' timing routine finds the number of cycles in a given piece of machine code

ASSEMBLY language is fast, but sometimes not fast enough. This utility won't speed anything up, but it will help you to weed out the parts of a program that are slowing you down, and perhaps find a quicker way of achieving the same aim.

It works out how many machine cycles any given piece of code takes to run, including unseen interrupts which the operating system might have to service during that code. It's particularly useful for timing operating system routines such as OSWRCH and OSBYTE, saving a long-winded process of disassembly, and helping you decide how to tackle a problem in the fastest manner. For example, take two different methods of testing to see if a key is being pressed: you could use an OSBYTE call with A=&79 (keyboard scan from key 16), or alternativley with A=&81, X=0, Y=0 (equivalent of INKEY (0)).

The former takes 1204 cycles, the latter 300. Quite a difference!

The program uses Timer 2 of the 6522 VIA chip. This can be organised to count down to zero at 1MHz (half the machine clock speed) from a given start time, and then generate an interrupt. The program starts this timer counting from a given value, and then executes the piece of machine code under test.

As soon as the timer reaches zero – which may happen while the test code is running or after it has finished, depending on the start time specified – the interrupt is generated, and the operating system passes control via the IRQ2 vector at &206-7 to a service routine, 'rupt', which simply sets a flag.

Once the code being tested has ended, the program looks at the flag to see if the interrupt happened while the test code was running. If it did, the countdown length was too short, so the flag is reset and the start time for Timer 2 is increased. This process is repeated until the interrupt happens just after the test code has gone through, so that the flag when read still shows zero. The number of cycles in the test code can then be calculated from the last start time.

Lines 10 to 60 organise some space into which the machine code can be assembled, and also set up the memory locations it uses, within that space. Zero page locations could have been used here, but you may wish to use the available zero page addresses (&70 to &8F) in the code you want to time.

Lines 110 to 210 store the OS IRQ2 vector address for safe keeping and replace it with the address of 'rupt', the new routine.

Lines 220 to 270 set up the 6522 VIA. This is a complicated chip, capable of many modes of operation, but put simply lines 220 to 240 organise the Auxiliary Control Register (&FE6B) to do what we want it to do – count down on Timer 2 – without messing up anything else it might be required to do (such as control a printer); and lines 250 to 270 ensure that the interrrupt request it will generate when it reaches zero is recognised by the CPU. If you want to earn a gold star from Acorn you could do all this using the proper OSBYTE 'write to Sheila' routines. Sheila, however, doesn't seem to mind being addressed directly.

Then follows the main loop. The start time for Timer 2 is stored in locations timelo and timehi (low byte, high byte), and to begin with this start time is incremented by 1. Timer 2 can only count down from a maximum number 65535 (&FFFF) – it only has two bytes to start from, and &FFFF is the biggest number you can put in two bytes – so if as a result of incrementing by 1 the carry flag is set at line 370, showing a number greater than &FFFF, the program gives up and exits (line 380). There shouldn't be any problem here. The longest routine I've found so far is a 'CLS' in Mode 0, which takes 109,454 machine cycles; this is 54,727 1MHz cycles, well within the limit.

Lines 390 to 440 reset the flag and start Timer 2 running by putting the two bytes of the start time into its registers (&FE68 and &FE69). The countdown starts as soon as the high byte is loaded.

Then follows the machine code you want to test. Lines 460 to 490 are only an example – they test the INKEY(0) function – but in practice you should delete these

```
10 DIM space 150
20 oldv=space
30 flag=space+2
40 timelo=space+3
50 timehi=space+4
60 timer=space+5
70
80 FOR I%=0 TO 2 STEP 2
90 P%=timer
100
110        [OPT I%
120        LDA&206              \store IRQ2V address
130        STAoldv
140        LDA&207
150        STAoldv+1
160        SEI
170        LDA#rupt MOD 256 \set new one
180        STA&206
190        LDA#rupt DIV 256
200        STA&207
210        CLI
220        LDA#&DF              \set up 6522
230        AND&FE6B
240        STA&FE6B
```

lines and insert your own code. It can be as long as you like, but if it exceeds about 50 bytes, increase the DIM statement in line 10. The only restrictions are that it should not interfere with the 6522 nor use IRQ2V, and that it should be 'self-contained' – don't go jumping back into Basic with an RTS!

After the code you want to test has finished, lines 510 to 530 look to see if Timer 2 ran out and generated an interrupt, signalled by a 1 in 'flag'. If it didn't, the start time was longer than the time needed to run the test code, and the program goes to 'exit'. If it did, a JMP instruction goes back to the main loop to try again. JMP is used rather than the more elegant BNE in case the code you want to test is too long for the assembler to 'BNE' over.

Assuming success, lines 550 to 640 set everything back to rights by restoring the old address to IRQ2V and resetting the 6522 so that it doesn't try to generate any more interrupts.

Lines 660 to 690 are the new interrupt routine – this simply puts a 1 in 'flag', clears the 6522 Interrupt Request Flag at &FE68 by loading it into the accumulator (which resets it automatically), and JMPs back to the operating system to end the routine.

The Basic part first asks you to specify a start time for the program to begin its trials, within reasonable limits. For most tests you can start with, say, 100. This value is then divided by two (remember Timer 2 counts at half the machine clock speed), and after applying a 'correction factor' of −2, of which more later, it is passed to the machine code routine in timelo and timehi.

After 'timer' has been CALLed to do the test, the successful start time is retrieved in the variable 'Y'. This is checked to see if it equals zero: the only way it could do so is if the incrementing in 'loop' resulted in a start time greater than &FFFF and the machine code routine had accordingly given up. If this is the case the program will admit defeat.

Y is then checked against X, the original trial start time. If it has only incremented by 1 this means the loop has gone round only once, and could be giving a false result – Timer 2 could still be counting down! So the program prompts you to try again with a lower start time.

This facility is useful if you are timing awkward routines, such as those which generate a sound – it can get very boring listening to a constant beeping noise while the program generates a few hundred 'VDU7's! Better to begin with a start time you know is too long and work downwards until the program accepts it.

If all is well, line 840 prints out the correct number of cycles, to the nearest highest even number. The correction factor of +2 has been included after field trials with test codes of known length. It appears that the 6522's interrupt isn't recognised until two 1MHz cycles after one would expect it. I can't explain this – perhaps someone else can. ●

```
250        LDA#&A0
260        STA&FE6D
270        STA&FE6E
280
290 .loop  CLC
300        LDAtimelo          \increment start time
310        ADC#1
320        STAtimelo
330        BCCon
340        LDAtimehi
350        ADC#0
360        STAtimehi
370        BCCon
380        JMPexit            \if >65535 give up
390 .on    LDA#0              \clear flag
400        STAflag
410        LDAtimelo          \start countdown
420        STA&FE68
430        LDAtimehi
440        STA&FE69
450
460        LDA#&81            \example
470        LDX#0              \only - put code
480        LDY#0              \to be timed
490        JSR&FFF4           \in here
500
510        LDAflag            \did interrupt happen?
520        BEQexit
530        JMPloop            \no - try again
540
550 .exit  SEI                \clean up and go
560        LDAoldv
570        STA&206
580        LDAoldv+1
590        STA&207
600        LDA#&20
610        STA&FE6D
620        STA&FE6E
630        CLI
640        RTS
650
660 .rupt  LDA#1
670        STAflag            \signal
680        LDA&FE68           \clear 6522 IRQ flag
690        JMP(oldv)          \back to OS
700        ]
710
720 NEXT
730
740 REPEAT
750   INPUT "Guess to start",X
760   UNTIL X>4 AND X<131074
770 X=X DIV 2 - 2
780 ?timelo=X MOD 256
790 ?timehi=X DIV 256
800 CALL timer
810 Y=256*?timehi+?timelo
820 IF Y=0 PRINT "greater than 131074 cycles":END
830 IF Y=X+1 PRINT "try lower":GOTO 740
840 PRINT 2*(Y+2);" cycles"
850 END
```

SNOWFLAKES AND OTHER MONSTERS

Remember fractals? Now Susan Stepney shows you how to program your Beeb to draw these 'monstrous curves'

IN THE October issue of *Acorn User* I introduced you to fractals, lines of infinite length that in theory can be drawn on an ordinary piece of paper. This seems so unlikely, if not impossible, that when fractals were first discovered mathematicians declared them to be 'monstrous curves'. The curves I described needed only a few lines of Basic to produce, but it was not really possible to predict from the start what they were going to look like. The program I am going to describe here, although somewhat longer, has the advantage of producing more predictable fractal curves (though some of them are only 'predictable' with hindsight).

One of the many curves it can draw is the famous (or infamous) 'snowflake'. The construction of a snowflake is simple. First draw an equilateral triangle (one with all the sides the same length and all the angles 60 degrees). Then in the middle of each of the three edges erect another equilateral triangle one-third the size. This gives a 'Star of David' shape, with 12 edges. In the middle of each of these edges erect a triangle a third as small again. And so on . . . The result after three steps is shown in figure 1a. As the number of replacements increases, the length of the curve increases without limit. The area of the 'final' snowflake, however, is only 8/5ths that of the original triangle.

If instead of erecting the smaller triangles on the outside, we make them point inwards, we get the result shown in figure 1b, an 'anti-snowflake' curve. Its area is only two-fifths that of the original triangle. You don't have to use only triangles, however. Figure 2a shows the result of using a square as the starting figure, and replacing each line by the curve shown in figure 2b. Although the edge of this figure gets longer at every step, its area doesn't change.

To describe these figures in general we first need some jargon. The original shape is called the 'initiator'. In figure 1 it is a triangle, in figure 2 it is a square. It doesn't have to be a closed curve; it could just as easily be a straight line, or any other space that takes your fancy. The first step in the construction of the 'monster' is to replace each line in the initiator by the 'generator' (see figures 1c and 2b). Then each straight line in the resulting figure is replaced by another generator, and so on. In theory this replacement is done an infinite number of times, resulting in a curve of infinite length. In practice, of course, only a finite number of replacements can be made before the resulting detail is too fine for the pencil or VDU to cope with.

So how do we program the BBC micro to draw 'monsters'? Obviously we will use recursion, since each line in a generator is replaced by a smaller copy of that generator, which itself has each line replaced, and so on. The program also has a 'stack' which holds the co-ordinates of the points, and a 'pointer' to point to the current position. The resulting program is very simple. In fact, more than half the lines in

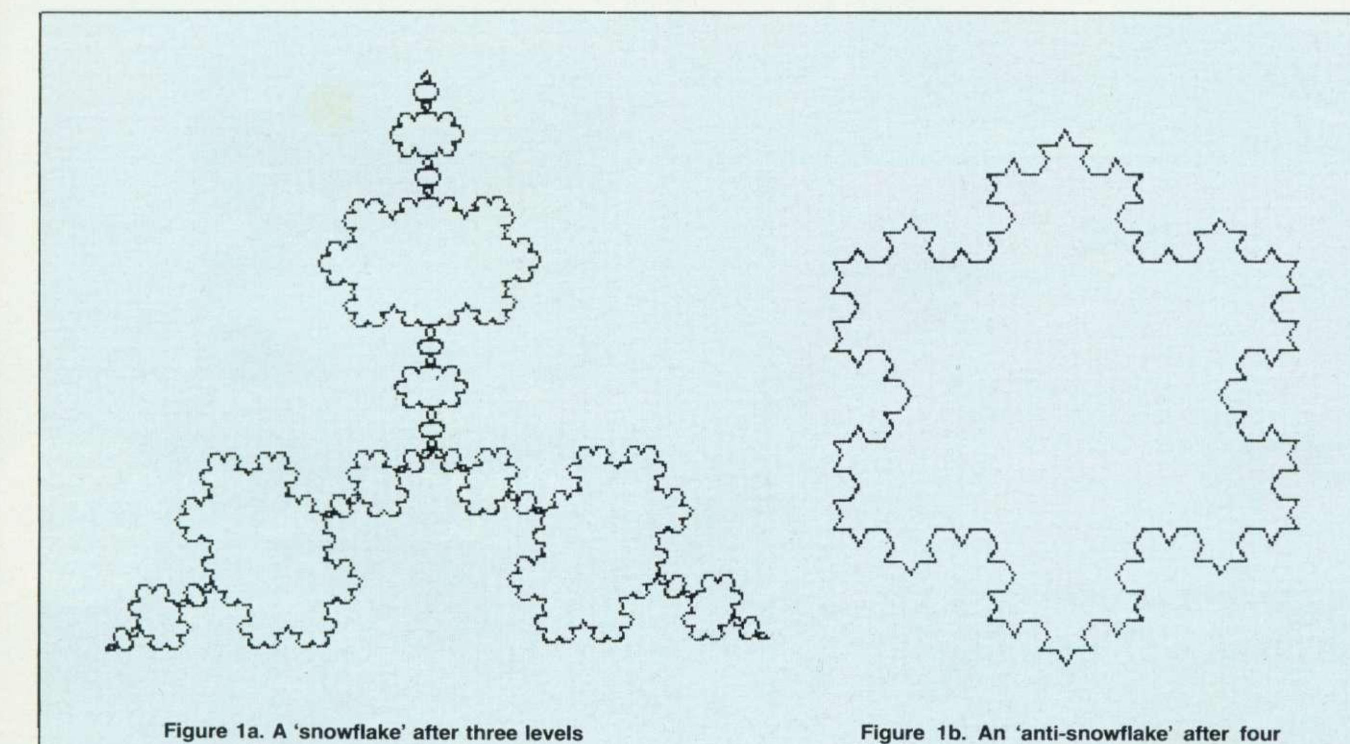


Figure 1a. A 'snowflake' after three levels of recursion

Figure 1b. An 'anti-snowflake' after four levels of recursion



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the final program deal merely with the input of the initiator and generator.

PROC_initiator asks whether a new initiator is required and fills the beginning of the stack with the initiator's co-ordinates, using the pointer P% to point to the last one. If a new initiator is required, PROC_input_initiator first asks for the number of vertices (it will be three for a snowflake). It then asks for their co-ordinates, assuming the bottom left-hand corner of the screen is (0,0) and the top right-hand corner is about (1.2,1). For a snowflake, suitable co-ordinates are 1/4,1/4, then 3/4,1/4 and 1/2,1/4+SQR3/4.

I have written them in this funny way to show that you can enter the co-ordinates as arithmetical expressions, which enormously simplifies entering the corners of triangles, for example. The last co-ordinate looks rather peculiar. An equilateral triangle with a side of length 1 has a height of SQR3/2. This triangle has a side of 1/2, hence a height of SQR3/4, and is shifted 1/4 of a unit up the screen. Hence SQR3/4+1/4. The procedure also draws the initiator on the screen, so you can check that you have got what you think you have.

PROC_generator and PROC_input_generator do the same three things for the generator. The generator for the snowflake has three points (the ends don't count since they have to be there anyway), with co-ordinates 1/3,0 then 1/2,1/(2*SQR3) and 2/3,0. (Can you see why we need a minus sign in the second co-ordinate?)

Finally, the program asks for the level of recursion. This should be fairly small (3-6), for two reasons. First, there is a danger of needing too much store for all the points and, second, it would take ages to draw, and you would not see any more detail, since the screen cannot cope. (If you are having problems seeing the patterns on a TV, try changing to mode 1.) The fewer the points there are in a generator, the more levels of recursion you can have before losing resolution.

So at the start, the stack holds the co-ordinates of the initiator, and the pointer points to the last of these. PROC_expand is then called. It checks to see if the current level of recursion (held in N%) is as deep as required (held in nrec%). Assuming for now it is not, PROC_replace is called. Its job is to replace a line by a generator (in fact, it replaces all the lines in a generator, or initiator, by smaller generators, accomplished by the J% loop).

First, the procedure updates the current level of recursion. The co-ordinates of the ends of the line to be replaced are held in x,ystack(P%) and x,ystack(P%−1). To replace the line, we need to rotate and expand the generator from (0,0), (1,0) to these two end points, add the new intermediate points to the stack, and update the pointer (being careful not to overwrite the position of the end of the line). This is done in the I% loop.

When the procedure has replaced all the

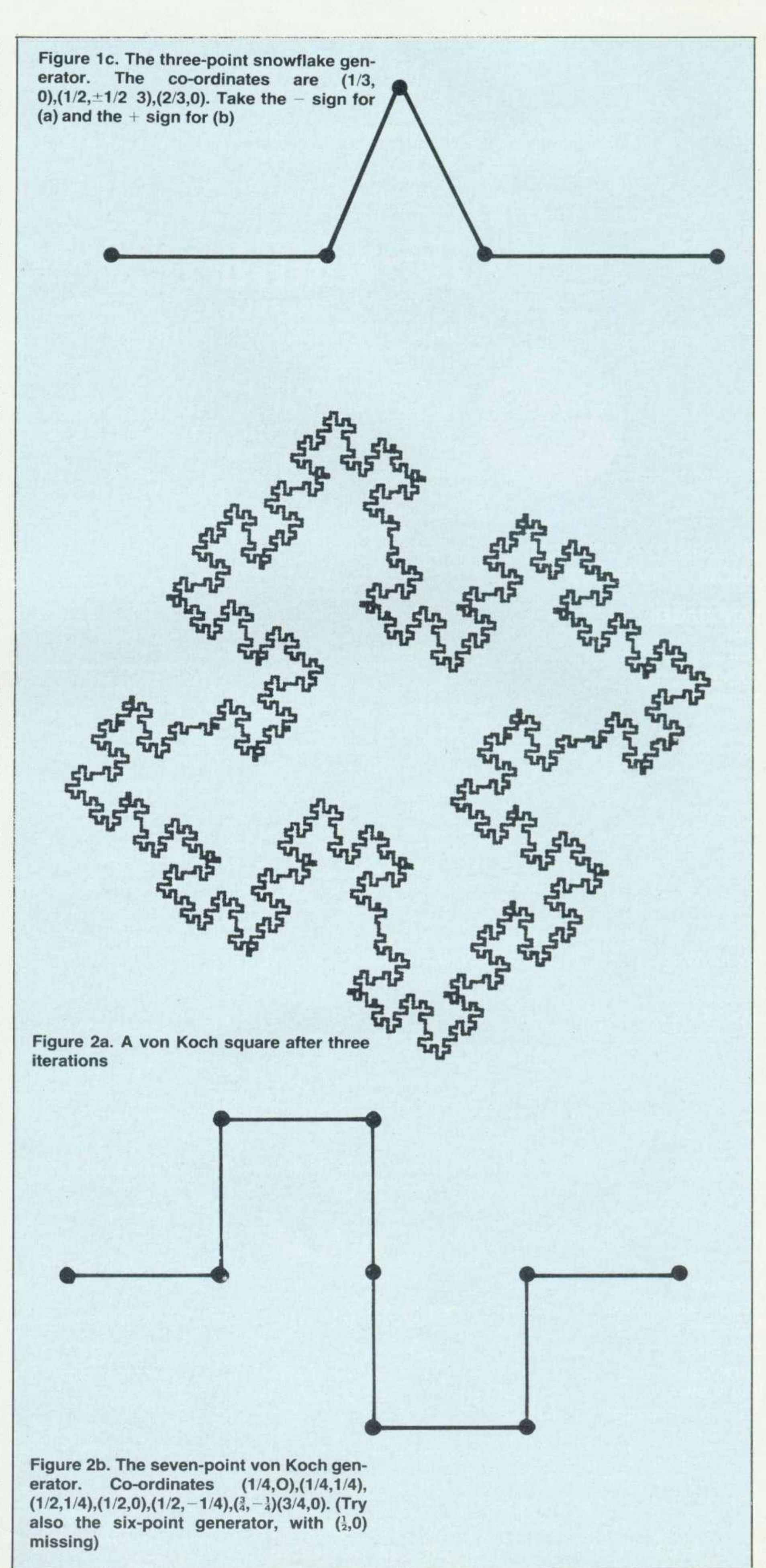


Figure 1c. The three-point snowflake generator. The co-ordinates are (1/3, 0),(1/2,±1/2 3),(2/3,0). Take the − sign for (a) and the + sign for (b)

Figure 2a. A von Koch square after three iterations

Figure 2b. The seven-point von Koch generator. Co-ordinates (1/4,O),(1/4,1/4), (1/2,1/4),(1/2,0),(1/2,−1/4),($\frac{3}{4}$,−$\frac{1}{4}$)(3/4,0). (Try also the six-point generator, with ($\frac{1}{2}$,0) missing)

lines in a generator by new generators, it decreases the level of recursion by one, and returns to PROC_expand. But note the call of PROC_expand inside the J% loop. This is the recursive part. The program replaces the last line in the figure by a generator, then the last line in that by a generator, until it has reached the right depth of recursion. Then it works its way back along the figure, replacing lines as required.

If the current level is the required deepest level, PROC_expand calls PROC_draw, which simply draws the generator on the screen, decreasing the pointer accordingly. In this way we find that we never have to store the co-ordinates of too many points. The programme ends when P%=0 – that is, when the pointer reaches the bottom of the stack and there are no more lines left to replace.

What can we actually use the program to draw? Although snowflakes and so on are very pretty, after a while they seem a bit boring, because they are so symmetrical The first step away from this regularity is shown in figure 3a. The initiator of this 'forest' is simply a straight line, while the generator is the offset spike shown in figure 3b. The lines to be replaced are of differing lengths, so the generators are magnified by different amounts. This gives a range of detail, which looks more inter-

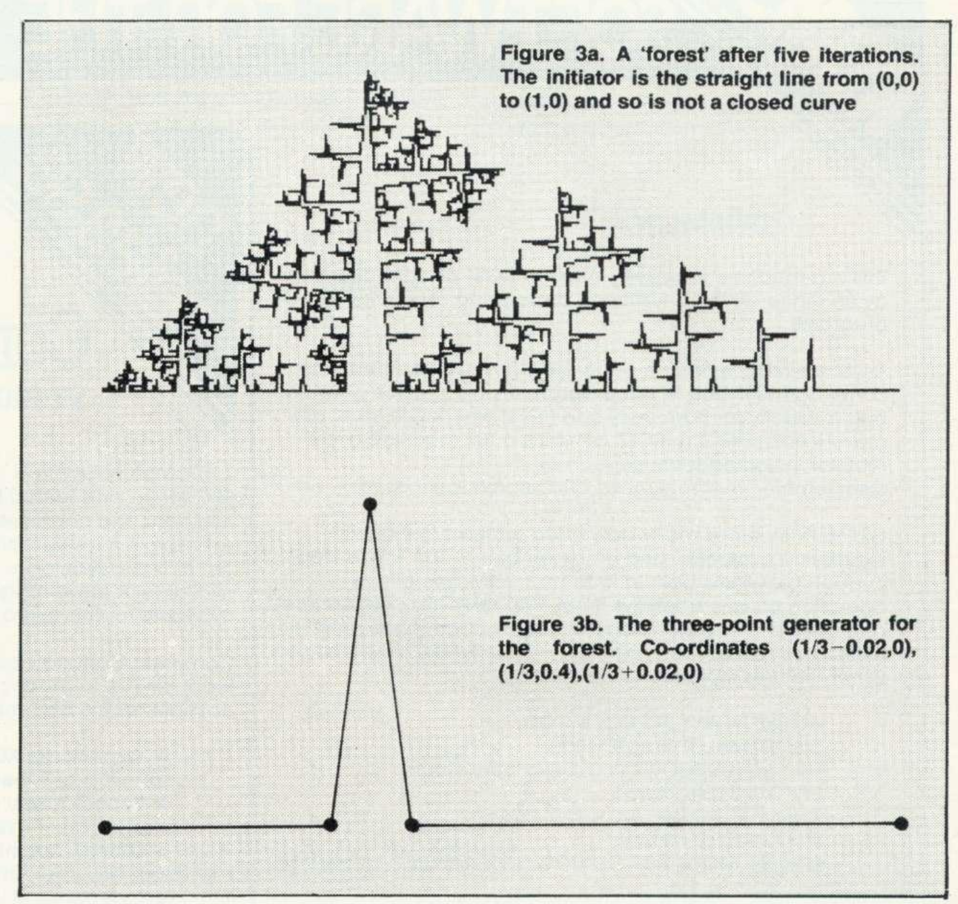


Figure 3a. A 'forest' after five iterations. The initiator is the straight line from (0,0) to (1,0) and so is not a closed curve

Figure 3b. The three-point generator for the forest. Co-ordinates (1/3−0.02,0), (1/3,0.4),(1/3+0.02,0)

```
   10REM ********************
   20REM *  Monster curves  *
   30REM ********************
   40REM
   50flag%=0
   60DIM xstack%(50),ystack%(50),xinit%(
10),yinit%(10),xgen(20),ygen(20)
   70REPEAT
   80MODE0
   90PROC_initiator
  100PROC_generator
  110INPUT"no of levels of recursion -
"nrec%
  120flag%=1:N%=0:MODE0
  130MOVExstack%(P%),ystack%(P%)
  140REPEAT:PROC_expand:UNTIL P%=0
  150PRINTTAB(0,0)"Q to quit, any other
key to continue"
  160UNTIL GET$="Q"
  170END
  180REM ********
  190DEFPROC_initiator
  200LOCAL I%,ans$
  210IF flag%=1 INPUT"Same initiator ? "
ans$
  220IF flag%=0 OR INSTR("NONono",ans$)>
0 PROC_input_initiator
  230FOR I%=1 TO cvert%
  240P%=I%-1
  250xstack%(P%)=xinit%(I%):ystack%(P%)=
yinit%(I%)
  260NEXT
  270ENDPROC
  280REM **********
  290DEFPROC_input_initiator
  300LOCAL x$,y$,I%,ans$,vert%
  310INPUT"no of vertices in initiator -
"vert%
  320FOR I%=1 TO vert%
  330PRINT"vertex ";I%;:INPUT" - "x$,y$
  340xinit%(I%)=EVAL(x$)*1000:yinit%(I%)
=EVAL(y$)*1000
  350IF I%=1 PLOT69,xinit%(I%),yinit%(I%
) ELSE DRAWxinit%(I%),yinit%(I%)
  360NEXT
  370INPUT"closed curve ?"ans$
  380IF INSTR("NONono",ans$)>0 cvert%=ve
rt%:ENDPROC
  390cvert%=vert%+1
  400xinit%(cvert%)=xinit%(1):yinit%(cve
rt%)=yinit%(1)
  410DRAWxinit%(cvert%),yinit%(cvert%)
  420ENDPROC
  430REM ********
  440DEFPROC_generator
  450LOCAL I%,ans$
  460IF flag%=1 INPUT"Same generator ? "
ans$
  470IF flag%=0 OR INSTR("NONono",ans$)>
```

continued on page 31

esting. (More interesting and realistic forests can be made using an initiator with two different-sized spikes; or put the generator inside a square instead of on a straight line to get a 'river' network.)

If we take this idea of irregularity a step further, reasonable 'maps' can be produced. Figure 4a, which (with a bit of imagination) resembles Iceland, was produced using an irregular pentagon as the initiator, and in figure 4b as the generator. You could use this program to generate maps of fictional worlds.

Some problems spring to mind:

1. Can you guarantee that the curve will not cross itself? You have no doubt found that random initiator and generator usually produce rather pretty 'scribble' on the screen.

2. Can you modify the program so that the generator does not have to be connected? In other words, can you produce 'offshore islands' (which, with the recursion, will have smaller islands off their own shores, and so on).

3. Can you modify the program to have more than one generator? For example, if in the case of the map in figure 4a you could randomly choose between that generator, and another with 'inlet', the result would be much less regular, and so more convincing. ●

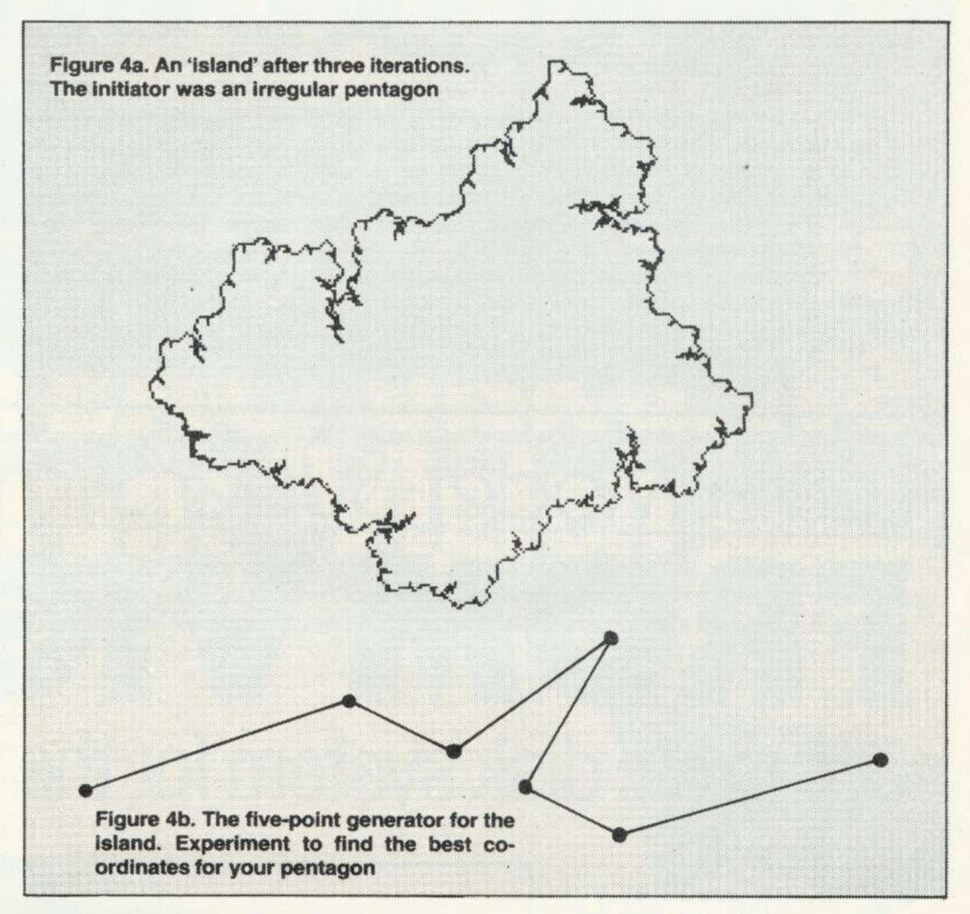


Figure 4a. An 'island' after three iterations. The initiator was an irregular pentagon

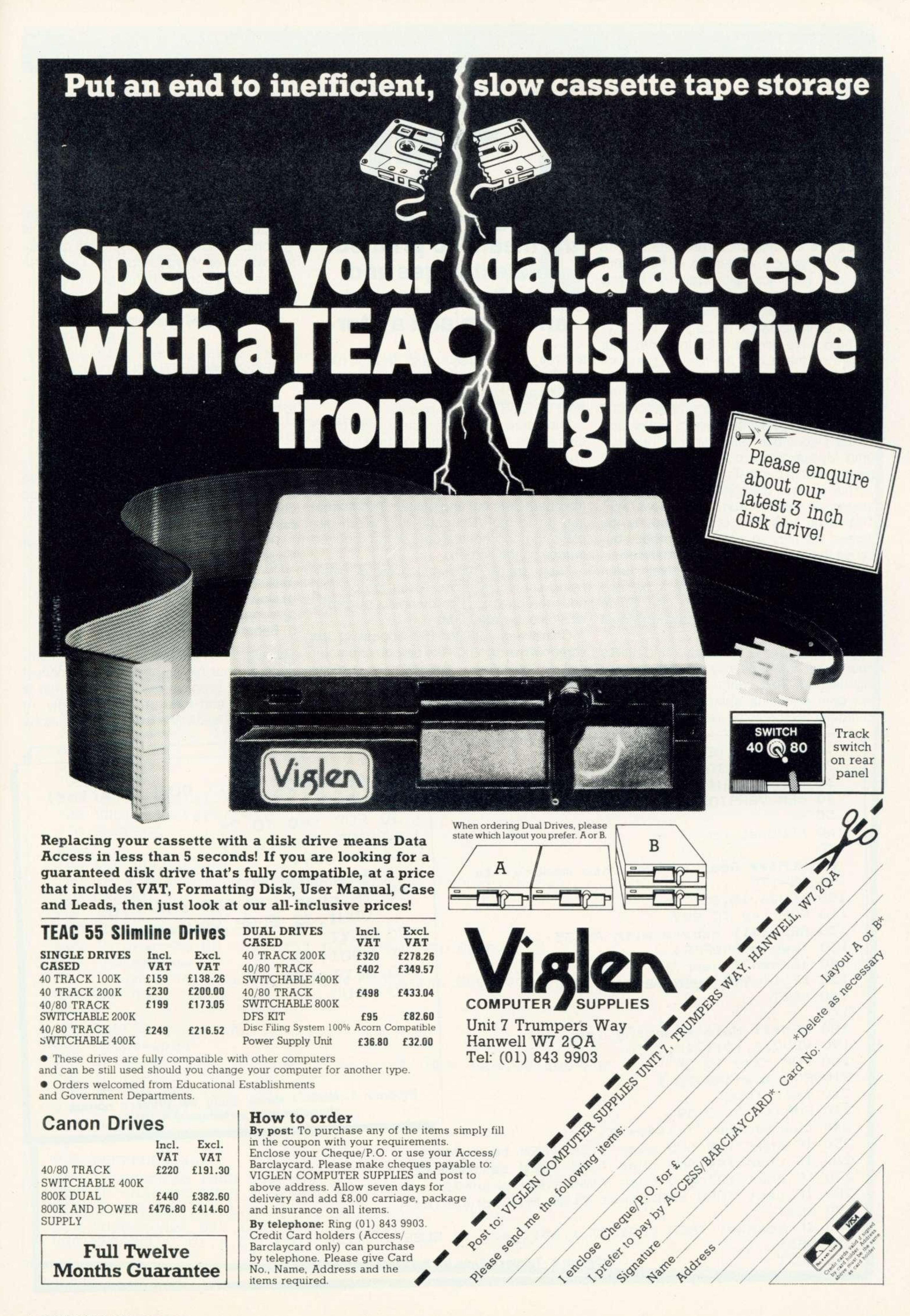
Figure 4b. The five-point generator for the island. Experiment to find the best co-ordinates for your pentagon

continued from page 29

```
0 PROC_input_generator
  480ENDPROC
  490REM ***********
  500DEFPROC_input_generator
  510LOCAL x$,y$,I%
  520PRINT"no of vertices in generator"
  530INPUT"not including ends (0,0) and
(1,0) -  "gen%
  540MOVE512,512
  550FOR I%=1 TO gen%
  560PRINT"generator vertex ";I%;:INPUT"
 -  "x$,y$
  570xgen(I%)=EVAL(x$):ygen(I%)=EVAL(y$)
  580X%=xgen(I%)*512+512:Y%=ygen(I%)*512
+512:DRAWX%,Y%
  590NEXT
  600DRAW1024,512
  610ENDPROC
  620REM **********
  630DEFPROC_expand
  640IF nrec%=N% PROC_draw ELSE PROC_rep
lace
  650ENDPROC
  660REM **********
  670DEFPROC_draw
  680LOCAL J%,jmax%
  690IF nrec%=0 jmax%=vert% ELSE jmax%=g
en%+1
  700FOR J%=1 TO jmax%
  710P%=P%-1
  720DRAWxstack%(P%),ystack%(P%)
  730NEXT
  740ENDPROC
  750REM ********
  760DEFPROC_replace
  770N%=N%+1
  780LOCAL I%,J%,jmax%,topx%,topy%,botx%
,boty%,diffx%,diffy%
  790IF N%=1 jmax%=vert%-1 ELSE jmax%=ge
n%+1
  800FOR J%=1 TO jmax%
  810topx%=xstack%(P%):topy%=ystack%(P%)
  820botx%=xstack%(P%-1):boty%=ystack%(P
%-1)
  830diffx%=topx%-botx%:diffy%=topy%-bot
y%
  840FOR I%=1 TO gen%
  850xstack%(P%)=diffx%*xgen(I%)-diffy%*
ygen(I%)+botx%
  860ystack%(P%)=diffy%*xgen(I%)+diffx%*
ygen(I%)+boty%
  870P%=P%+1
  880NEXT
  890xstack%(P%)=topx%:ystack%(P%)=topy%
  900PROC_expand
  910NEXT J%
  920N%=N%-1
  930ENDPROC
```



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PAGING TELETEXT!

George Hill devises the means to print out teletext pages and mode 7 graphics onto an Epson and a Star

MODE 7 is the screen mode most widely used when memory is at a premium. In mode 7 it is possible to produce a wide variety of effects, including seven-colour text and graphics, with optional flashing colours. The graphics characters are low-resolution teletext characters, on a 3 by 2 matrix as indicated in figure 1.

There have been articles in *Acorn User* before on the use of the teletext graphics set. I refer you particularly to the one in the September 1982 issue, which gave an excellent statement of the pros and cons and explained how the system works, and to the December 1983 Hints & Tips column. My task is not to show how to use the system, but to dump its results on a printer.

The screen memory consists of four 'pages' of memory from &7C00 to &7FFF. This is far less than is taken up by the screen memory in any other mode, because the mode 7 memory is organised on the basis of characters, not of pixels. Each character occupies an oblong 'box', and the form is clearly shown in the *User Guide* on pages 486 to 489, even to the individual dots within each letter.

There are some misprints, and these need to be noted, as they affect the dumping method. Text characters 95 and 224 are both underline characters. Graphics character 36 should be identical to character 164, and character 255 is a full block graphics character, not backspace. The '*' in the box for character 141 is incorrect on both text and graphics pages.

The screen is 40 characters wide by 25 characters deep, requiring 1,000 bytes. The four pages of memory give 1,024 bytes – enough and to spare! The bytes are passed to the teletext chip which sorts the characters out and passes the information on to the VDU controller, which displays the appropriate dots at the required places on the screen.

There are two types of 'character' occupying screen memory. These are printing and non-printing. For dumping purposes let's take the latter first.

Characters 128 to 159 appear in the screen memory and take up one character cell on the screen, appearing as a blank space. They affect printing characters *after* themselves, on the same line. For example character 130 is the 'alpha green' character, and subsequent characters are *(a)* alphabetic and *(b)* green; character 147 is 'graphics yellow', and subsequent characters will, even if typed from the keyboard, appear as graphics characters in yellow.

Try typing:

PRINTCHR$147;"abcdefg"<RETURN>

or

*FX226,144<RETURN>
<SHIFT function key3>abcdef

to try the effects.

*FX226,128<RETURN>

will return the keys to normal.

When dumping the screen we shall have to take note of all the effects of these characters on those which follow, but must print a blank space in their place.

The printing characters come in four kinds. These are:

a) Normal alphabetic
b) Double-height alphabetic
c) Normal graphics
d) Separated graphics.

There are non-printing characters to introduce all four types, and others to cancel them. Our problem is to sort out what is expected, and then print accordingly. At the start of each line the 'default' is alpha

```
 10 REM MODE7 TEXT DUMP (failed)
 20 VDU2
 30 FOR Y=0 TO 24
 40 FOR X=0 TO 39
 50 I=40*Y+X
 60 char=I?&7C00
 70 IF char>128 AND char<160
    VDU1,32 ELSE VDU1,char
 80 NEXT
 90 VDU1,10
100 NEXT
110 VDU3
```

Program 1. Mode 7 dump using the printer's normal character set – an honourable failure

```
 10 REM TELETEXT DUMP
 20 REM FOR STAR GEMINI 10X
 30 REM G.B.HILL (c) NOVEMBER 1983
 40 REM VERSION3
 50
 60 PROCset_up
 70
 80 REM*** Read screen into memory ***
 90 A%=135
100 VDU26,15,30
110 FOR I=0 TO 999
120 REM call osbyte with A=135
130 !user=USR&FFF4
140 screen?I=user?1
150 IF I<>999 THEN VDU9
160 NEXT
170
180 REM*** Main scanning loop ***
190 VDU2,1,10;1,10,1,10
200 FOR Y%=0 TO 24
210 FOR scan%=0 TO 1
220 text=TRUE
230 FOR X%=0 TO 39
240 char=screen?(Y%*40+X%)
250 IF char>128 AND char <136 THEN text=TRUE
260 IF char>144 AND char <151 THEN text=FALSE
270 IF char>127 AND char <160 THEN char=32
280 IF text THEN PROCptext ELSE PROCpgraphics
290 NEXT
300 IF scan%=1 THEN VDU1,27,1,65,1,6,1.10 ELSE VDU1,27,1,65,1,3,1,10
310 NEXT
320 NEXT
```

Program 2. Teletext dump for the Star Gemini 10X

Figure 1. The graphics characters for codes 55 and 237, and the 'numerical decoding' of them

```
330 VDU1,27,1,50,1,10,1,10,3,7
340 END
350
360 REM*** Procedures ***
370
380 DEFPROCset_up
390 DIM user 3,screen 999
400 DIM table 15,special 17
410 REM set table values
420 FOR I=0 TO 15
430 READ table?I
440 NEXT
450 REM set special character values
460 FOR I=0 TO 17
470 READ special?I
480 NEXT
490 REM graphics character table
500 DATA 224,225,227,231,226,233,230,235
510 DATA 228,229,234,236,232,237,238,239
520 REM special character table
530 DATA 91,166,92,206,93,167,94,164,95,241
540 DATA 123,204,124,207,125,204,126,191
550 ENDPROC
560
570 DEFPROCptext
580 IF scan%=1 THEN VDU1,32:ENDPROC
590 IF char=163 THEN char=96
600 IF char=223 THEN char=35
610 IF char=224 THEN char=95
620 char=char AND &7F
630 IF (char>90 AND char<97) OR (char>122 AND char<127) THEN PROCspecials ELSE
VDU1,char
640 ENDPROC
650
660 DEFPROCspecials
670 IF char=96 THEN VDU1,27,1,55,1,1,1,35,1,27,1,55,1,0:ENDPROC
680 I=-2
690 REPEAT
700 I=I+2
710 UNTILspecial?I=char
720 VDU1,special?(I+1)
730 ENDPROC
740
750 DEFPROCpgraphics
760 IF scan%=0 THEN PROCgraphics1 ELSE PROCgraphics2
770 ENDPROC
780
790 DEFPROCgraphics1
800 IF char=35 OR char=223 THEN VDU1,35:ENDPROC
810 PROCswapem
820 IF index=4 OR index=5 THEN PROCptext ELSE VDU1,table?(char MOD 16)
830 ENDPROC
840
850 DEFPROCgraphics2
860 PROCswapem
870 IF index=2 OR index=4 OR index=5 THEN VDU1,32:ENDPROC
880 IF index=3 THEN VDU1,226
890 IF index=6 THEN VDU1,228
900 IF index=7 THEN VDU1,232
910 ENDPROC
920
930 DEFPROCswapem
940 IF char=96 THEN char=35
950 IF char=95 THEN char=96
960 char=char AND &7F
970 index=char DIV 16
980 ENDPROC
```

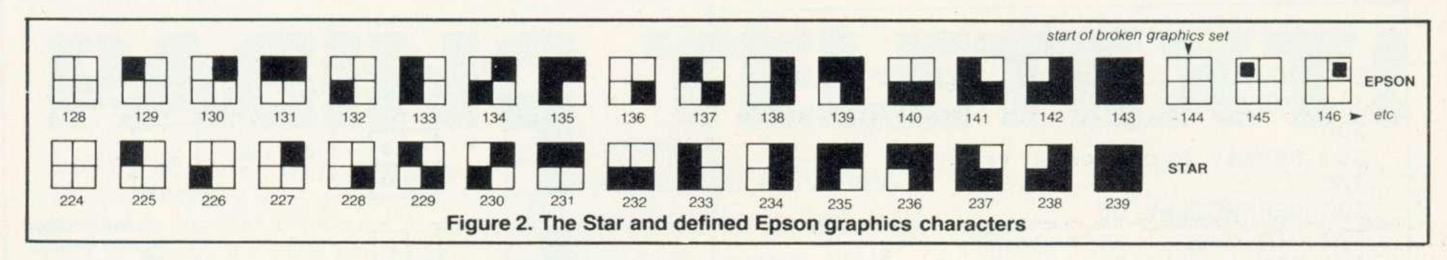


Figure 2. The Star and defined Epson graphics characters

white, steady colour on a black background.

Let's take the text characters first. We have an ASCII-type of character set from 32 to 126, with some anomalies, which occur at ASCII values 91 to 96 and 123 to 126. Location 127 is the delete character, which cannot by definition occur on the screen! I shall refer to characters in this range as the mode 7 set, whether text or graphics.

The true teletext character set occurs from 128 to 225. These are the characters transmitted by Ceefax and Oracle. Characters 128 to 159 are the non-printing characters already referred to; characters 160 to 225 are a 'British ASCII' set (if that is not a contradiction in terms). These are almost identical to the previous set, but with the £ and # signs swapped, and character 255 representing a block of colour. This is the character used for the 'copy cursor' when you use the cursor control keys in mode 7 program editing.

At first, therefore, it seemed sensible to try to dump the mode 7 text characters by using the printer's normal character set, and program 1 represents my first effort in this direction. The problem that immediately becomes apparent is in the method of screen scrolling employed in this mode. This means that address &7C00 doesn't always represent the top left character on the screen! To correct this I have used the operating system command OSBYTE with the accumulator set to 135 (the equivalent of *FX135), which reads the ASCII code of the character at the current cursor position.

The section of code here is of more general importance, and represents a useful tip. Define four bytes of memory with

```
DIM user 3
```

Now put A%, X% and Y% equal to the three 'arguments' of a *FX call. Then

```
!user=USR(&FFF4)
```

User?0 gives the accumulator contents; user?1 gives the X register contents; user?2 gives the Y register contents; and user?4 gives the status register contents.

In the case of *FX135, only A% needs setting and the value of the character code is deposited in the X register, accessed by user?1.

In programs 2 and 3, when reading the screen into memory, 'default windows' are restored, 'paging' is switched off, and the cursor is homed to the top left of the screen (VDU26,15,30). A character is read. The value is stored in a block of memory reserved for the purpose. The cursor is advanced (VDU9) and the next code read. The block of memory thus prepared is our

Figure 3. Flow chart of programs 2 and 3

'screen image', and it is this image that will be dumped. This copying process could be speeded up by a machine code routine, but as it only takes a few seconds I don't think it worthwhile.

The cursor movement is visible on the screen, and it is desirable from the aesthetic point of view to prevent the cursor from going past the bottom right-hand corner position, as it then causes a black line to appear at the bottom of the screen. This doesn't damage the dump, but it is unsightly.

Dumping of text is quite straightforward in theory. For most of the characters it is merely necessary to extract the ASCII code and translate it directly into the required printer character. This means that all characters with codes greater than 160 must have 128 subtracted, as printers normally keep their character sets in the range 32 to 126. First, however, two problems must be overcome: the 'mixed-up' characters, which do not appear in the same relative positions in the mode 7 and teletext sets, must be sorted out (these include # and £); and there are some mode 7 characters which do not have equivalents in the normal printer set. I have designated them 'specials' and dealt with them in a separate procedure. How you cope with them depends on the printer you use and its facilities.

This is a natural point to raise the question of whether or not this method is suitable for your printer. To use a direct equivalent of the method you must have the following facilities, or some suitable alternative: either block graphics characters of the type illustrated in figure 2 (or of some similar type), *and* the ability to control the amount of paper fed at each linefeed *and* some special characters in an extra character set; or user-defined characters which you can use mixed with

This column contains the value of character_code MOD 16, which represents the *blue* shading.

These are the character_codes

This row contains the values of character_code DIV 16, which represents the *green* shading. These numbers are the values of 'index'

2	3	4	5	6	7	MOD 16
32	48	64 @	80 P	96	112	0
33	49	65 A	81 Q	97	113	1
34	50	66 B	82 R	98	114	2
35	51	67 C	83 S	99	115	3
36	52	68 D	84 T	100	116	4
37	53	69 E	85 U	101	117	5
38	54	70 F	86 V	102	118	6
39	55	71 G	87 W	103	119	7
40	56	72 H	88 X	104	120	8
41	57	73 I	89 Y	105	121	9
42	58	74 J	90 Z	106	122	10
43	59	75 K	91 ←	107	123	11
44	60	76 L	92 ½	108	124	12
45	61	77 M	93 →	109	125	13
46	62	78 N	94 ↑	110	126	14
47	63	79 O	95	111	127	15

Figure 4. The modified character set. The blue character cells are identical in any horizontal row and are printed during the first scan. The green character cells are identical in each vertical column and are printed in the second scan. The text occurs in columns 4 and 5

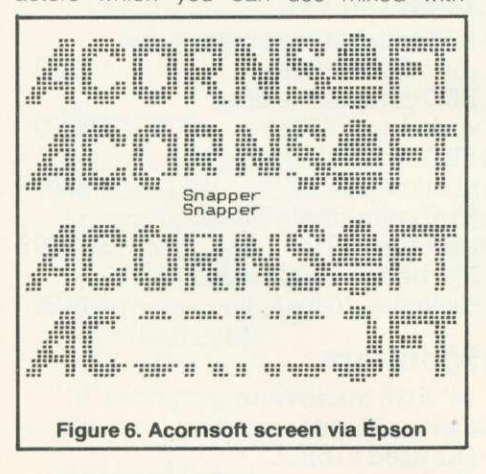


Figure 6. Acornsoft screen via Epson

```
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
pqrstuvwxyz{|}
←½→↑¼‖¾÷−£■⁄,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{/}~Ø
```

Figure 5. Epson character set

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normal characters on the same line *and* the ability to control linefeed.

You may be able to use a combination of these two things. Also you should select the USA character set, either by means of the DIP switches, or by inserting the necessary code (normally an escape sequence) into the dump program.

The printing of the graphics characters presents three difficulties. First, the two graphics sets (mode 7 and teletext) do not agree exactly, so the anomalies must be sorted out. Second, the graphics character set contains a complete set of ASCII capital letters in the middle of it. These will have to be extracted and printed as text. Third, the printer graphics set will probably have characters equivalent to only the top four 'boxes' of the six-membered teletext 'box'. This means printing the graphics characters in two 'nibbles'. This is illustrated in figure 4. A variation in linefeed will be necessary unless you have a complete teletext character set on your printer, as did the old Microline 80.

Programs 2 and 3 are dumps for the Star Gemini 10X and Delta 10 (and possibly the 510), and for the Epson FX80 respectively. They differ in that the Star dump relies totally on the characters available from the printer's own ROM, while in the Epson dump all the necessary extra characters have been defined using the 'download characters'. The basic method is the same for both.

The Epson characters were defined using my 'character generator' suite of programs, which allows you to define characters on a screen grid and automatically save them to disc files for subsequent loading. A version is also available for tape use, though the filing facilities on tape are not so extensively used. Details of the package are shown in the panel. The program for the Epson includes a file-loading routine which will load characters stored in file 'C. TTCHARS' into the character generator, and program 4 will allow you to generate the necessary file.

And so to the programs themselves. The principal difference in capabilities is that the Epson can cope with 'broken' graphics whereas the Star prints all graphics as continuous. The flow-chart (figure 3) summarises the programs. The basic method is:

1. Read the screen into memory.
2. Default to 'text mode' at the start of each line, and read each line twice.
3. Read characters from memory, till the end of the line. Non-printing characters are checked for first, and adjustments to the flags for text and graphics are made, and a space printed. The printing characters are passed either to PROCptext or PROCpgraphics.
4. PROCptext deals with the text characters. Text characters are printed only on the first scan. The necessary switching around is carried out to make the teletext set coincide as much as possi-

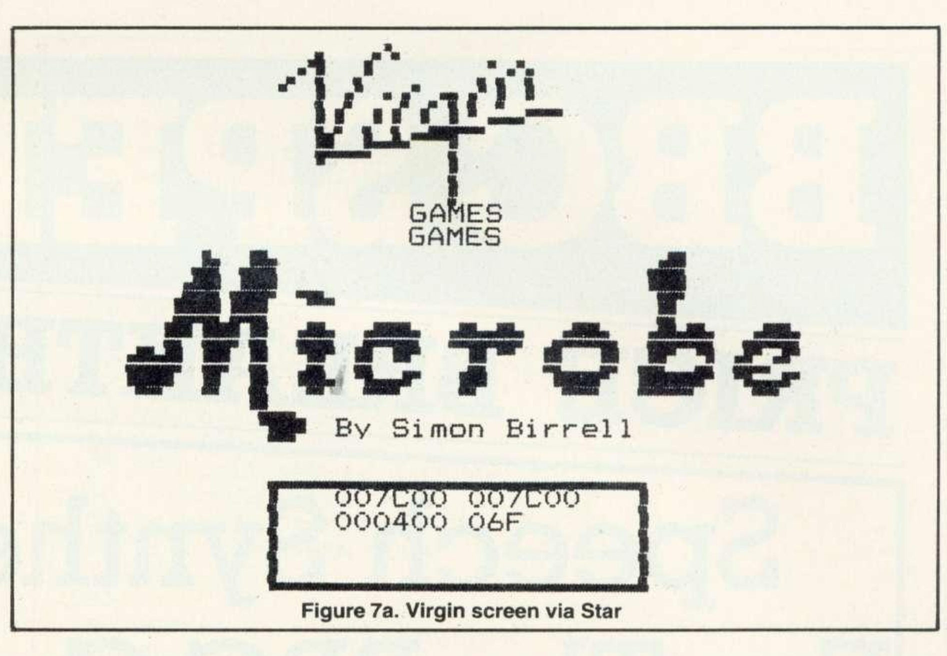


Figure 7a. Virgin screen via Star

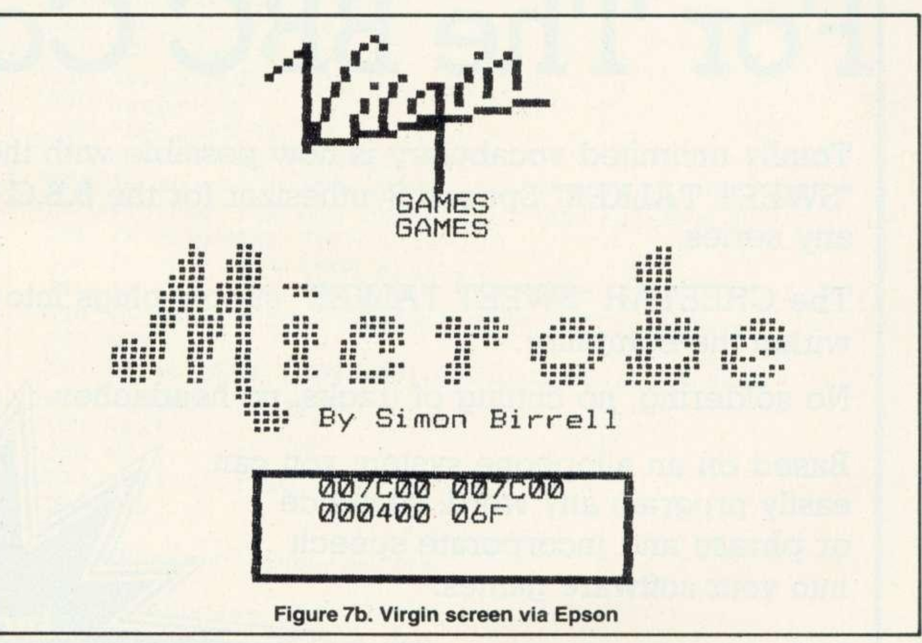


Figure 7b. Virgin screen via Epson

```
↑s        CEEFAX 153  Mon 12 Dec   12:05/24
Weather eye              Forecast: 24
                         hours from
                         noon today

          Rain, sleet or snow in
          eastern England will die
          out, with clear periods
          overnight leading to frost
          and fog patches.

          Clear periods in W England
          and Wales, cloudy with
          rain tomorrow. Sunny
          periods in Scotland and
          N Ireland, wintry on high
          ground. Cloudy with rain
          tomorrow. Rather cold,
          southeast very cold.

Outlook for the next 48 hours:
Cloud and rain in west, spreading to
most parts, then bright and showery.
Mild, becoming colder, generally windy.
```



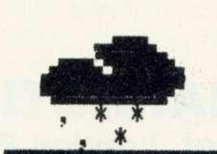


Figure 8. Ceefax weather report via Star

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ble with the USA character set on the printer, and the codes are then ANDed with &7F. This subtracts 128 from the teletext characters, but leaves the mode 7 characters unaffected. It thus ensures that they match up with the printer's text characters. Special characters are passed to PROCspecials to decode from the table. Blanks are printed on the second scan.

5. PROCpgraphics deals with the graphics characters. The characters are passed to different routines for the first and second scans. In the first scan the # sign is printed to get it out of the way, then PROCswapem switches around some characters which differ in mode 7 and teletext. It then produces an index number (char DIV 16, where 'char' is the current value of the character code), which allows the routine to decide whether to print a text character (index=4 or 5) or a graphics character. Figure 4 illustrates the relationship between the printed characters, the index and the 'doctored' values of the character-codes. PROCedures graphics1 and graphics2 take the requisite action on scans 1 and 2, by selecting a character either from the table or from the defined character set via 'base'.

6. The necessary alterations to linefeed are carried out, and the processes repeated for each line until the page-end is reached.

7. The linefeed is reset to its normal default value, the paper fed a little, a beep made, and the printer disabled.

A word or two about the graphics 'table' of characters for the Star and the 'special' table of characters for both printers. The 'table' contains the codes of the graphics characters corresponding to the value of char MOD 16 (see figure 4) in ascending order. The 'special' table contains first the ASCII-type code of the character followed by the code of the printer equivalent. You can amend these values to suit your own printer. The Star, you will see, did not have a 3/4 character, so I had to repeat 1/4. The complete character set for the Epson printer is shown in figure 5.

The routines will not do everything. As already stated, the Star dump takes no notice of the broken graphics characters. They take no account of the colour of characters in either text or graphics, nor of changes in background colour. They do not recognise the function of 'hold-graphics' as I never found it used, and remain unsure of its meaning. Finally, and most unfortunately, they fail to take any notice of double-height characters, feebly printing the letters twice. I found no way of dealing with the double-height characters, lacking double height on the printers.

The routines do, however, produce small, rapid, pretty accurate representations of the mode 7 or teletext screens, as the example pictures show. The introduc-

▶to page 146

```
   10 REM TELETEXT DUMP
   20 REM FOR EPSON FX80
   30 REM G.B.HILL (c) NOVEMBER 1983
   40 REM VERSION 2
   50 REM with file reading routine
   60
   70 PROCset_up
   80
   90 REM*** Read screen into memory ***
  100 A%=135
  110 VDU26,15,30
  120 FOR I=0 TO 999
  130 REM call osbyte with A=135
  140 !user=USR&FFF4
  150 screen?I=user?1
  160 IF I<>999 THEN VDU9
  170 NEXT
  180
  190 REM*** Main scanning loop ***
  200 VDU2,1,10,1,10,1,10
  210 FOR Y%=0 TO 24
  220 FOR scan%=0 TO 1
  230 text=TRUE
  240 base=128
  250 FOR X%=0 TO 39
  260 char=screen?(Y%*40+X%)
  270 IF char>128 AND char <136 THEN text=TRUE
  280 IF char>144 AND char <151 THEN text=FALSE
  290 IF char=153 THEN base=128
  300 IF char=154 THEN base=144
  310 IF char>127 AND char <160 THEN char=32
  320 IF text THEN PROCptext ELSE PROCpgraphics
  330 NEXT
  340 IF scan%=1 THEN VDU1,27,1,65,1,6,1,10 ELSE
VDU1,27,1,65,1,3,1,10
  350 NEXT
  360 NEXT
  370 VDU1,27,1,50,1,10,1,10,3,7,13
  380 END
  390
  400 REM*** Procedures ***
  410
  420 DEFPROCset_up
  430 DIM user 3,screen 999
  440 DIM table 15,special 21
  450 REM set table values
  460 FOR I=0 TO 15
  470 READ table?I
  480 NEXT
  490 REM set special character values
  500 FOR I=0 TO 21
  510 READ special?I
  520 NEXT
  530 REM graphics character table
  540 DATA 224,225,227,231,226,233,230,235
  550 DATA 228,229,234,236,232,237,238,239
  560 REM special character table
  570 DATA 91,160,92,161,93,162,94,163,95,168,96,169
  580 DATA 123,164,124,165,125,166,126,167,127,170
  590 REM Load character generator from file
  600 CH=OPENIN("C.TTCHARS")
```

▶ page 146

TWO PANS OF CHIPS

The heat's on as more stick-in boards for the Beeb hit the market. Joe Telford chips in with this round-up review of two sideways boards and a plateful of ROMs

OVER the past couple of months the postman has beaten a regular, almost daily, trail to Telford Towers. Hardly a week has passed without another firm advertising its latest offering of 'stick-in' boards and ROMs for the BBC micro. This month we look at a selection, some of which I have in regular use, and some of which I use er. . . less regularly. Before looking at the chips, we should examine the available frying pans: expansion ROM boards.

The expression 'frying pan' is not unwisely chosen, because whichever expansion ROM board is fitted to the BBC micro, the internal heat increases as more EPROM chips are added. It appears that while ROM chips use a few thousandths of an amp of current each, their EPROM brothers can use more than 50mA per chip. This means that a full 12-slot ROM expansion board can be drawing well over half an amp of power. Add this to the drain for disc drives, and it could be bye-bye, power supply. In effect, expansion ROM boards must really earn their keep.

Two boards turned up on the doorstep recently, and as I have been accumulating chips at an increasing rate, I decided to fry a selection.

WATFORD ELECTRONICS BOARD

At a time when expansion boards were hard to come by, Watford Electronics achieved a minor miracle in shipping one to me.

Being somewhat of a hardware man in my early days, and then never having seen another expansion board, I didn't flinch when I opened the package and saw six flying leads, four of which were to be soldered directly on to IC76 to provide the enabling signals. (However, I was drunk at the time! A more sober Telford would have called out the engineers.) Along with the circuit board, which was very well produced, was an A4 sheet of instructions, which detailed the operation of mounting the board. A DIL header is provided at one end of the board to push-fit into an already existing ROM socket.

This done, the board sits on plastic legs and covers much of the user RAM in the BBC micro. The ROM which is removed from the BBC micro can be fitted to the expansion board. The pins of the DIL header are so solid that they seem to permanently widen the grips of the ROM socket into which they fit (perhaps I shouldn't have removed the board).

To get round the problem of the six flying leads, the first two were plug-in connections to the BBC micro. The set of four which were to be attached to IC76 were soldered to a 16-pin DIL header, which was pushed into the socket along with IC76.

The Watford board has a number of facilities that are extremely useful. Apart from the standard set of 12 extra 16k ROM sockets, the sockets can be configured in various ways:

1. RAM in socket 15
2. Auto select of RAM socket on write signals
3. 8k ROMs accepted
4. 4k ROMs accepted
5. 2k ROMs accepted

The means of configuring the sockets is via a set of links on the board itself.

The ROMs and EPROMs should be fitted carefully into the sockets, remembering that the micro will now try to power up in the language in the highest-numbered socket. I proceeded to add EPROMs from ROM socket 4 upwards, ensuring that I had Basic in socket 14 (socket 15 is two 8k sockets and best left for RAM).

By the time I had reached ROM socket 9 I was very impressed with the board. I fitted an EPROM into socket 10, switched on and performed a *CAT on my disc drive. The system crashed. With any more than eight EPROMs (including Basic) and the disc drive using power from the BBC micro, the system produced garbage. I used an external power supply for the discs, with the result that the garbage was reduced. Reducing the number of EPROMs to seven removed the problem totally.

On contacting Watford to check the problem, a helpful gentleman explained that it sometimes arose because of inadequate buffering on the BBC micro. Watford were prepared to cure this shortcoming by buffering the expansion board, if it was sent back to them. At the time of writing I am awaiting its return.

It costs £35.44 (inc P&P and VAT) from Watford Electronics, Cardiff Road, Watford, Herts.

ATPL SIDEWISE BOARD

Sidewise is constructed to a slightly higher quality than the Watford board. There are only two flying leads, fitted to connectors on the main logic board. Sidewise dis-

- The complete AMS disc drive package, tailored to your BBC micro, is compatible with all disc interfaces and includes cables, a comprehensive manual and utilities on disc and EPROM. Housed in a steel case, matching the BBC micro; these reliable and robust Hitachi 3″ disc drives are the ultimate for home, office and classroom.
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- The AMS package includes utilities on both a disc and an EPROM for formatting and verifying discs. The EPROM, which is easily fitted, offers a simple to use and permanent alternative to using the utilities disc.
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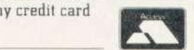
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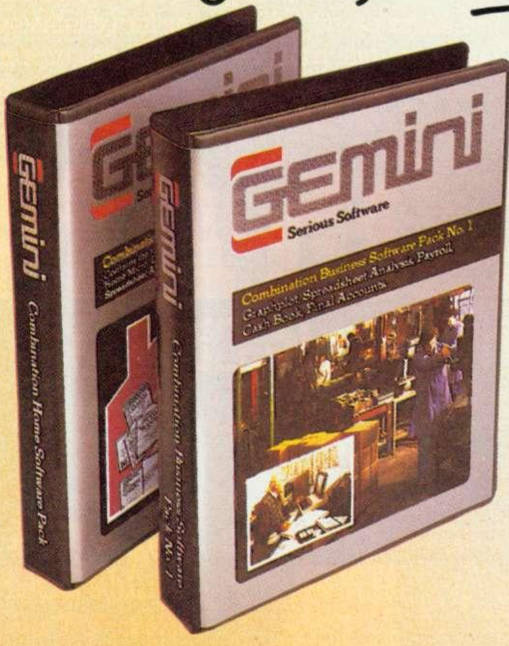
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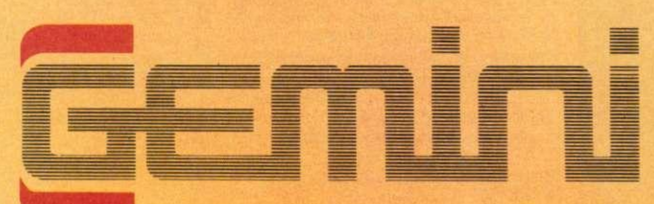
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places the OS ROM and the analogue chip. These sockets are then used for signal takeoffs and to stabilise the board physically. The chips can be refitted on Sidewise. The manual consists of four sheets of A4 in a card cover but deals with all the important aspects of fitting and using the board.

Sidewise has a number of facilities, again set by links, which include:

1. RAM in socket 15
2. Onboard battery backup for RAM
3. 16k ROM
4. 8k ROM
5. 4k ROM

At present I still have Sidewise in my machine, with 10 EPROMs permanently in place. I was about to invest in RAM and a battery backup but I've just seen an Aries board, and of course that takes up the same physical space as Sidewise. Other than that, I am very pleased with Sidewise.

It costs £44.70 (inc P&P and VAT) from ATPL, Station Road, Clowne, Chesterfield, Derbyshire, S43 4AB.

CHIPS ON REVIEW

These can be split into two groups:

Languages:
Forth
Pascal
Logo
XCal
Utilities:
Disc Doctor
M-UTS

It is not possible in the space available to give an in-depth review of each of the chips available, so here is an outline of what each one does with my impressions as to their usefulness.

The language chips are interesting to Acorn users because they allow us to move away from Basic towards applications which require purpose-built languages. Every language chip reviewed here requires a disc drive to store programs. This is less of a fault than many may imagine, because users who wish to apply any language (including Basic) practically will know the benefit of disc drives. The difficulty of learning a new language is exacerbated by slow, unreliable equipment. Serious work requires discs. All the ROMs except Disc Doctor are available from HCCS Associates, 533 Durham Road, Low Fell, Gateshead, Tyne and Wear, NE9 5EY (tel: 0632 921924).

Forth: This 8k ROM comes complete with a well-written spiral-bound manual which, being only 88 pages long, is more of a user's guide than a beginner's handbook. The ROM can be easily fitted into any free socket, and when called with the command:

*FORTH

it answers:-

FORTH
Forth V2.5

at which point the user can begin to type in Forth words. Because Forth allows words to be defined which can in turn define other words, Forth programs tend to be quite concise, for example, typing:-

: PLUSES BEGIN 43 EMIT SPACE AGAIN ;

defines the new word PLUSES to mean 'print a + then a space forever'. Typing the word:

PLUSES

will result in the screen being covered with plus signs. To cancel this effect the break key is pressed, which returns us to a

FORTH
COLD/WARM?

prompt. We can start again without recently defined words by typing 'C' or start again with our words like PLUSES, by typing a 'W'. To remove a word we should, for example, type

FORGET PLUSES

Unlike the other language ROMs, the manual shows how Forth can load and save to tape. Forth will also allow the user to communicate with the BBC machine operating system with the word MON, which replaces the OS '*' symbol. Forth also allows users to implement sound and graphics with little difficulty. A typical program is shown in listing 1.

```
: SQ DUP MINUS DUP 2DUP
  MOVE
  ROT DUP DUP MINUS
  DRAW
  DUP DUP DRAW
  OVER SWAP DRAW
  DRAW
;

: DIA DUP MINUS 0 MOVE
      0 OVER DRAW
      DUP 0 DRAW
      0 OVER MINUS DRAW
      MINUS 0 DRAW
;

: PERSIAN
  2DUP 0 DO 4 ABSRND 8 ABSRND GCOL
             I SQ DUP +LOOP DROP
        0 DO 4 ABSRND 8 ABSRND GCOL
             I DIA DUP +LOOP DROP
;
```

Listing 1. A typical program in Forth, in which a square and diamond shape are interlaced

The program is called by the line:

2 MODE 640 512 DGO 8 500 PERSIAN

The program defines a square and a diamond then interlaces them in a Persian carpet-type routine. The value of the program is that it shows some of the structure of Forth, as words define other words, and the final program executes very quickly indeed.

The language looks formidable at first, but it is structured, fast, and interesting to learn. Forth costs £34.72 (VAT and P&P extra).

Pascal T. This is a 16k implementation of Pascal in EPROM. Like the Forth chip, it is


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written by Joe Brown and is quite a powerful implementation for a 'tiny' Pascal. The ROM is supported by a Pascal reference manual of 93 pages, again a user's guide rather than a beginner's primer. The language is, however, not difficult to learn, and with a few hours' toil users can become adept. The value of Pascal to me is that it forces good programming habits, which should improve normal Basic programs.

Once the EPROM is fitted into the micro, powering up and typing:

*PASCAL

results in the message:-

PASCAL
Pascal-T
++

As with Forth, users are offered a cold/warm start opportunity after pressing break. Pascal programs may be typed directly into the computer, which is messy, or entered via text buffers, which is probably the best way. Direct entry of text is messy because the language compiles each line as it is typed, repeating on the screen during syntax checking. A single error at this stage means that the whole program must be retyped. In addition, directly typed programs are very difficult to save.

The direct command NEWTEXT gives users access to a 2k text buffer which will allow routines to be written, amended, saved and compiled. Saving is to disc, and the language alters the allocation of disc space so that 49 2k files can be used on a 40-track system or 98 on an 80-track drive.

A whole program may consist of a number of source text files which are sequentially loaded into the BBC and compiled. Each load operation destroys the previous text buffer contents. The method of editing in the text buffer is quite tedious, but concentrates the mind wonderfully.

Facilities include:-

S 2	Insert a blank line 2
ER 7	Erase line 7 leaving gap
DL 7	Delete (close) line 7
CH 6	Change line 6 for. . .
L. 8	List up to line 8

Although the language is based around Forth, it operates quite speedily and behaves very much as a purely Pascal language. The manual warns that bugs might occur. I found no language bugs, but I had some problems loading and saving. These were overcome after phoning the company, and should generally provide no problems. The procedures with discs is:

1. Format a new disc.
2. Select the 40TR or 80TR command in Pascal.
3. Set the drive number, eg DR1.
4. Initialise the disc with IDISC.

Other disc commands are CAT, COPY, LOAD, SAVE, DELETE, LOCK and UNLOCK.

The Pascal-T vocabulary includes:

+ — * ( ) = <> < > <= >= := : ; , . '
[]\AND ARRAY BEGIN CASE CONST DIV DO DOWNTO ELSE END FOR IF IN NOT OF OR PROC PROGRAM REPEAT THEN TO UNTIL VAR WHILE

Standard types:

BOOLEAN CHAR INTEGER

Standard functions and procedures:

ORD READ FX CHR WRITE OSWORD ABS LN TAB MOD

Readers will see many similarities between Pascal and Basic in listing 2. This serves to make the language easier to learn. The extensions to structure which Pascal allows, such as 'WHILE' and 'CASE', make returning to BASIC quite annoying.

```
 0 PROGRAM ftoc;
 1 CONST
 2     freezing  = 32;
 3 VAR
 4     degf,degc : INTEGER;
 5 BEGIN
 6     WRITE('temp in F ; ');
 7     READ (degf);
 8     degc := ((degf - freezing)
*5) DIV 9;
 9     LN; WRITE('temp in C =',degc);
10     LN
11 END
```

Listing 2. A typical Pascal program, with its strong echoes of Basic

I see this ROM as a learning package, and as such may find its way into educational establishments where languages other than Basic are the rule. It has much to recommend it, but it is not really an applications package. Pascal-T costs £59 (VAT and P&P extra).

Logo-Forth: This is the latest offering from HCCS. Most readers will be aware of the Logo language. Most Logo implementations have been 'Toy' Logos which concentrated on turtle graphics, rather than on the language itself.

Pure Logo is rich in procedures and other structures. Logo-Forth aims to put matters to rights. The 16k EPROM comes complete with a 200-plus page manual which contains programs, advice and the more technical user information. Bona fide educational users may copy parts of the manual for classroom use. The ROM requires a disc system and uses a similar data entry and filing technique to that of Pascal.

So far so good. Demonstration programs are provided within the language to allow turtle graphics to be controlled from the keyboard, or from a small joystick, which can be connected to the analogue port. Construction details for this device are given.

The language itself is easy to get into, but is as deep as Basic. This is because the core of the language is Forth (again!). Even quite young children can define shapes using turtle graphics, and the Logo-Forth vocabulary. For example, a 7-year-old wrote a simple program:

```
TEACH RECTANGLE
CS
RED INK
100 FWD
90 RT
300 FWD
90 RT
100 FWD
90 RT
300 FWD
90 RT
END
```

However, there is a great gap between this simple approach and the suggestion in the manual that we can pass parameters to the defined procedures. One approach from the manual is:

```
TEACH RECTANGLE
2DUP
FWD 90 RT
FWD 90 RT
FWD 90 RT
FWD 90 RT
END
```

and then we call the routine with:

```
CS BLUE INK 300 100 RECTANGLE
```

Readers will be able to see the Forth-like thread to the language. I believe that because Forth is so tied up with machine



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architecture the user must at least understand the use of stacks. This means that parameter passing and advanced programming are probably best left until secondary school. The alternative is to stand education on its head and teach these formal concepts to young children. Hands up who goes first!

The Logo-Forth vocabulary is extensive and allows direct access to the graphics, sound, and operating system of the BBC micro. Many facilities are easy to use and it becomes possible for children to produce fast multicoloured graphics. It should also be possible for computer-literate teachers to provide the language learning environments of micro-worlds within the Logo framework. Young children could then give commands (English words) which would animate part of a picture, resulting in a great learning stimulus. Words which exist include:

LEFT RIGHT UP DOWN PENUP PENDOWN INK RED BLUE YELLOW WHITE BLACK PAINT REPEAT *FX CASE DRAW FENCES MODE SHOW HIDE SOUND ENVELOPE PRINT" PADL DEMO NEWTEXT NOFENCES OSWORD MOVE LARC LCIRC RARC RCIRC

The full list is long and includes user-defined graphics and access to the FX calls of the BBC operating system.

Logo-Forth is not the easiest Logo to handle, but then it has by far the most facilities available. It can be used at all levels, from very young children to adults. As an unbeliever, I often shrug off new languages other than Basic by asking: 'Ah . . . but can it blow EPROMs?' The use of Forth in this novel implementation leads me to believe the answer is 'Yes'. I am using Logo-Forth to gain a better understanding of Forth, and my daughter aged 6.75 is using the same language to explore angles.

The only caution I express about Logo-Forth is that it would be unwise to rush children into it. As with the 'toy' logos, children don't learn in a vacuum; for the value of Logo to be felt, they must have other experiences, discussion, guidance and an overall monitoring of progress. Leaving children to play with a powerful language like Logo-Forth does them little service.

Logo-Forth costs £59 (VAT and P&P extra).

XCAL: Another 16k EPROM from HCCS. Xcal comes with two discs of additional routines and a short manual. It is a package for education, providing a do-it-yourself computer-aided instruction system, which users can configure to include text, graphs, questions or histograms, then this can be replayed to individual students as part of a course. The package may be best suited to further education, or to the learning-by-numbers associated with the armed forces.

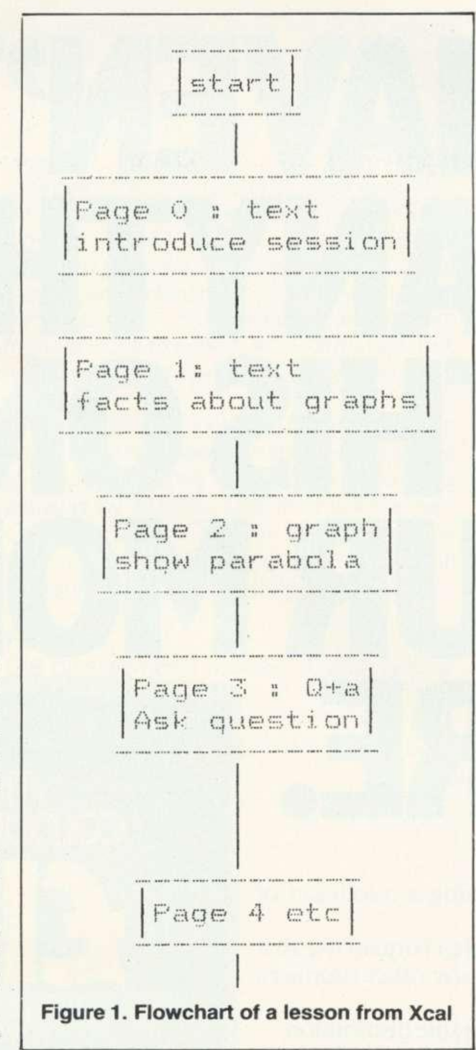


Figure 1. Flowchart of a lesson from Xcal

The lesson content is best laid out as a flowchart (who uses these things nowadays?). The example of figure 1, adapted from the manual, shows how the flowchart connects 'pages' of the lesson. Once a page has been created it should be stored on disc. Pages can be created in any order and amended if required. When the lesson is complete a copy can be printed out for checking and for future reference.

I found the package cumbersome, because of the extra disc required. Although thin, the manual was useful, but I would have preferred greater detail in how to create pathways through the lesson, to cope with both remedial students and highfliers within the same structure. Few teachers seemed interested in the package, because they felt that building up a library of materials would be a long, hard slog; because twin disc drives are needed; and because few of them up to FE level approve of this form of instruction, it being similar in their minds to the 'failed' teaching machines of the '60s.

I don't make much use of this package, other than for demonstrations. Xcal costs £65 (VAT and P&P extra).

1M-UTS: This is an 8k machine code utility EPROM for the BBC micro. It operates in two different modes, the first being a selection of * commands which can be called from within Basic. The second is in the dedicated role of a machine code monitor which provides its own prompt. Typing *HELP MONITOR gives a list of the functions available (see figure 2).

To help with the monitor, a short manual is provided which covers all the commands, at the user manual level rather than at the beginner's level. A knowledge of machine code is obviously required to handle the complete range of functions available in the monitor, but even a beginner could get some use from the EPROM.

Commands

Disc drive commands

FORM formats 40 or 80 track discs. In doing so, it corrupts memory up to PAGE+&300.
VERIFY checks that each disc can be read correctly.
GET downloads the contents of a track from a disc into memory, between PAGE and PAGE+&A00.
PUT copies memory from PAGE to PAGE +&A00 on to the specified track of a disc.

Memory commands

Some of the more interesting commands are:
SAME compares two areas of memory for differences.
MOVE moves the contents of a block of memory to a new location.
MEM gives a hex/ASCII dump of memory.
FIND scans memory to match a byte string.
EDIT allow a a block of memory to be altered via a screen editor.
CHANGE allows a byte string to be placed at a location in memory.

Machine code/assembly programming

ASSEMBLE invokes a macro-assembler in a separate ROM (not provided).
BASE sets the address for disassembly.
DIS dissembles machine code.
GO executes a machine code routine.
WHERE finds breakpoints.
SET sets breakpoints.
CLR clears breakpoints.
ONBRK instructs the monitor what to do when a breakpoint is encountered.
STEP single-steps through a machine code routine.
LOOK allows disassemblies to be examined by scrolling up and down through them on the screen.
REGS prints out the contents of the registers.

Other commands

SELECT selects a ROM for examination or disassembly.
VDU sends a byte string to the screen via OSWRCH.
MODE changes mode (VDU and MODE would not normally be allowed outside of Basic).

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CALC evaluates expressions in denary, binary, hex and octal.

1M-UTS is a very useful tool for the machine code user, with some extra support for discs. I tend to use this utility mainly for debugging machine code, but it seems good value at £19.95 (VAT and P&P extra).

DISC DOCTOR: This is an 8k chip from the same stable as Wordwise (see full review last month, page 141). First I should point out what I dislike about the version which I had for review. It won't let my (borrowed) Z80 second processor boot CPM. Remove DD and success, add DD and failure. However, as 99% of users don't have second processors, I suppose this won't matter too much.

Disc Doctor is a little like M-UTS, in as much as it is a collection of utilities aimed mainly at disc users.

Disc Doctor comes complete with a 39-page spiral-bound manual which carefully explains each command. Basic and machine code programmers alike should be able to make good use of the ROM, which is always active within the machine. Even if *TAPE is typed, Disc Doctor can, for example, format discs. After formatting, users will find that they are still in the tape system.

Typing *HELP DISC DOCTOR gives the list of facilities available (see panel in last month's review) some of which are offered by M-UTS as well. Indeed, some of the names are identical. The result is that because any * command is passed from highest ROM to lowest, the ROM which has the highest number will intercept the command first.

I have DD in socket 10 and M-UTS in socket 9. This means that I generally use all of Disc Doctor's facilities and the extras allowed by M-UTS. This is of course personal preference. We are approaching the time when a BBC language expansion standard needs drawing up among firms.

Facilities

DIS disassembles memory, but semi-inteligently, allowing files of disassembled code to be stored on disc.

DISCTAPE and TAPEDISC allow files to be copied from one media to the other with a single command line. This is very useful. It conflicts with DIS in M-UTS.

DOWNLOAD loads from disc into memory, then relocates.

DSEARCH searches a disc for a string of characters and allows editing facilities if the match occurs.

DZAP. Here it is on a plate – direct editing of any sector of a disc, just by typing DZAP.

EDIT offers a simple command to allow function keys to be edited. It conflicts with EDIT in M-UTS (I prefer the use of FLIST as in M-UTS).

FIND searches a Basic program for keywords, strings or characters. Unfortunately, keywords must be entered as hex values. It conflicts with FIND in M-UTS.

FORM formats a disc. One super benefit here is that my system will let me format discs to 43 tracks. Disc Doctor gives me absolute control of the number of tracks formatted, so I get an extra 7k per disc. Conflicts with FORM in M-UTS.

JOIN joins several files together. Really these are best as text files, or at least similarly organised files.

MENU auto-menus discs. Raw users can press M_BREAK to get a menu of a disc, and then load the program of their choice.

MOVE relocates a Basic program in memory. Conflicts with MOVE in M-UTS.

MSEARCH searches for memory for a specified string. On finding the string the memory editor will allow users to alter the string if required.

MZAP invokes the memory editor. Both MZAP and DZAP are well laid out on screen, so that locations can be altered by cursor movement and Hex, ASCII or binary input.

PARTLOAD allows part of a long file to be loaded.

RECOVER copies a number of sectors from disc into memory. I normally use this as a last resort before giving up on a disc.

RESTORE replaces the sectors from memory on to a disc.

SHIFT relocates the contents of a block of memory.

SWAP allows up to 60 filenames on a disc.

VERIFY, as on M-UTS, with which it conflicts.

I use Disc Doctor regularly and am very impressed with it. M-UTS may win hands down on value for money, but Disc Doctor is a very high quality package. Decide on your own interests, then buy the one which suits.

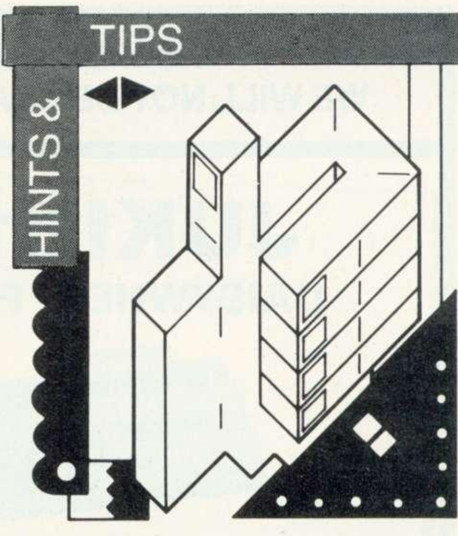
Disc Doctor costs £29 (plus VAT) from Computer Concepts, 16 Wayside, Chipperfield, Herts.

If I was looking for only two useful ROMs from the lot, I would choose Disc Doctor and Logo-Forth as the most impressive of the selection. ●

```
MONITOR 1.40

  ASSEMBLE <fsp> <fsp>
  BASE <addr>
  CALC <expr>
  CHANGE <addr> <byte string>
  CLR (<addr>)
  DIS <strt>(..<end>) (H<prefix>) (P,L)
  EDIT <addr>
  FLIST (<number>)
  FORM <tracks> <drv>
  FIND <strt>(..<end>) <byte string>
  GET <track> (<drv>)
  GO <addr> (<A>) (<X>) (<Y>)
  LOOK <addr> (H<prefix>)
  MEM <strt>(..<end>) (P,L)
  MODE <mode>
  MONITOR
  MOVE <src> <dest> <len>
  ONBRK <command line>
  PUT <track> (<drv>)
  REGS
  SAME <addr> <addr> <len>
  SELECT <rom number>
  SET <addr>
  STEP <addr> (H<prefix>) (P,L)
  VDU <byte string>
  VERIFY <drv>
  WHERE
```

Figure 2. The 27 utilities available on 1M-UTS



CASSETTE CARE:
HOW TO AVOID A LOAD OF TROUBLE

FOLLOWING last month's hints about overcoming simple faults, I'll continue with my consideration of the weak link of a computer system, the cassette recorder. Cassette recorders were designed as a cheap means of reproducing low-fidelity sound. Used with computers they are stretched to the limit of their performance. As a result, the cassette recorder needs to be well maintained. There are problems that are seldom evident in audio work, but when the cassette is used as a data recorder these can make the difference between loading and not loading. Try the following if your tape recorder is not giving the performance you would like.

Clean the tape heads often. There are two heads on most small cassette recorders, the erase head and the record/replay head (diagram 1). The latter needs regular cleaning, as does the pinchwheel and capstan. To do this, take off the lid above the tape mechanism, if this is possible. This lid can be removed from most cassettes once opened with the eject button by pressing the two restraining clips underneath the lid. Press them gently or they will break. If the lid can be removed, the task of cleaning is easier but removal is not essential. Don't try to take the lid off the Ferguson 3T07 cassette recorder as this has a different restraining mechanism which often breaks when the lid is removed.

Clean the inside of the cassette using a tape cleaning kit or – to save expense – a packet of cotton buds and a tin of lighter fluid. Put the cassette into the PLAY position as this makes the heads easier to get at. Treat the heads gently to avoid scratching them. Also clean any dirt or fluff out of the compartment. Do not use a cleaning tape – this is abrasive and will wear out the heads quickly.

If loading becomes difficult and the cassette has been cleaned, then the tape heads could be out of alignment. To record and replay properly the record/replay head must be positioned parallel to the tape. There is a small cross-head screw, usually covered by a dab of paint, at the left of the record/replay head to make adjustments. Most cassettes have a small hole to enable you to turn this screw while the tape is playing. Its position is shown on diagram 1. Insert a tape into the mechanism and listen to it as it is playing. Turn the screw in either direction with a small screwdriver until the sound is clear and sharp and rather tinny (it is like turning the tone control up). Always use a pre-recorded tape such as the Welcome tape to do this, never a copy.

Readers who have a Ferguson 3T07 will find no hole for the adjustment. There is a hole in the plastic, however, under the aluminium plate. If you use a sharp instrument over where the hole should be with the head in the play position you will be able to dent the metal easily. Then all you need to do is drill a small hole through the aluminium plate – this is not as difficult as it sounds!

Head alignment is not confined to old cassette recorders. I have found many new data cassettes with badly aligned heads. They can easily go out of alignment and this needs frequent checking for. Has anyone any ideas as to why they go out of alignment once set?

A tape-head demagnetiser is a useful device. As the heads become magnetised, so loading and saving become difficult and you have to keep increasing the volume until it becomes critical. The BBC micro should accept a volume range of more than two-thirds of the total volume range of the recorder. A tape head demagnetiser can be bought at any good electrical shop and is quick and simple to use.

Most cassettes switch off the internal microphone automatically when a DIN plug is inserted into the socket. Check that your cassette does this by talking while making a recording from the computer. Play the tape back and listen for your voice. If you can hear your voice as well as the recording then insert the blanking plug supplied with the machine into the microphone socket to cut out the internal microphone. Hitachi cassettes need this plug; the modified Ferguson cassette and the BBC data cassette do not.

Avoid using C60 and C90 cassettes,

THESE problem pages, presented each month by Martin Phillips, offer simple hints and tips and answer queries from readers concerning the BBC micro and Electron and BBC Basic. If your letter is published you earn £5 for your trouble!

If you have a query on some technical hitch or a worrisome aspect of programming, please supply full details and make your question specific. It is not enough just to say that you are getting the error message 'No room' or 'Dim space' – there are, of course, a number of reasons why a program will run out of memory. A diagnosis can be made only with full information on the program, the style of programming, the techniques employed, whether discs or Econet are being used, and so on. Include a listing where appropriate.

We cannot reply to letters individually, nor can we return listings.

Write to: Hints & Tips, Acorn User, 53 Bedford Square, London WC1B 3DZ.

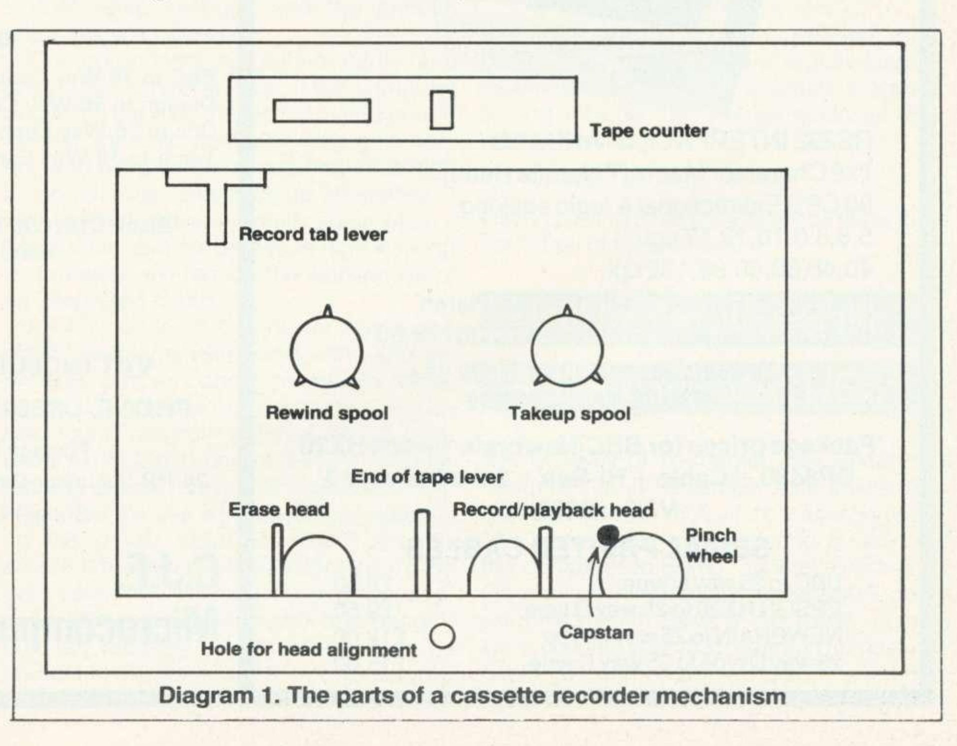


Diagram 1. The parts of a cassette recorder mechanism

```
   10 REM listing 1
   20 REM version for Basic 2
   30 ON ERROR PROCerror
   40 PINT"HELLO"
   50 END
   60
30000 DEFPROCerror
30010 *FX4,0
30020 VDU22,7
30030 REPORT
30040 PRINT
30050 error$="L."+STR$(ERL)+CHR$
10+CHR$10+CHR$13
30060 *FX15,1
30070 FOR I%=1 TO LENerror$
30080 A=ASC(MID$(error$,I%,1))
30090 OSCLI("FX138,0,"+STR$(A))
30100 NEXT I%
30110 END
```

Listing 1.

```
   10 REM listing 2
   20 REM version for Basic 1
   30 DIM char 10
   40 ON ERROR PROCerror
   50 PINT"HELLO"
   60 END
   70
30000 DEFPROCerror
30010 *FX4,0
30020 VDU22,7
30030 REPORT
30040 PRINT
30050 error$="L."+STR$(ERL)
+CHR$10+CHR$10+CHR$13
30060 *FX15,1
30070 FOR I%=1 TO LENerror$
30080 A=ASC(MID$(error$,I%,1))
30090 $char="FX138,0,"+STR$(A)
30092 X%=char MOD 256
30094 Y%=char DIV 256
30096 CALL &FFF7
30100 NEXT I%
30110 END
```

Listing 2.

because with frequent use and rewinding over a small part of the tape it winds unevenly inside the cassette and will slow down or jam. Buy C12 or C15 cassettes instead.

Make a copy of your tapes where possible and keep the originals safe. Most software firms will accept that this does not break the copyright laws – some even advise you to do this. BP Educational programs actually come with a spare cassette label, for your copy, and a spare slot in the folder for the cassette.

Magnetic fields will erase tapes over a long period of time. Strong magnetic fields are found near TVs, monitors, loudspeakers and coils of mains wiring, so keep your tapes away from these.

BUFFERS AND BAFFLES

THE BBC micro has proved a reliable computer, but it has a few weaknesses. One weakness appears to be in the cassette port. On some computers, the cassette port buffers have failed, due, it seems, to the cassette lead being removed while the computer is switched on.

This is a long-standing problem that has affected the Beeb since it was first produced. At one time Acorn started to fit the buffer IC in a socket, but they have since stopped this. I must confess I have unplugged my cassette from the computer many times while they are still switched on with no harm. Has anyone a suggestion as to why it should just affect some computers? Or could it be the individual cassette recorder? The cure is simple – don't connect or disconnect anything while it is still switched on.

Another problem still evident is overheating. This has been made worse on the new machines by the installation of a baffle at the back to stop anything being poked through the ventilation slot. Computers with this baffle get very hot. The addition of Econet, disc interface and the speech chips doesn't help either.

One component that suffers badly here is the disc controller chip. If the computer accesses the disc frequently over a period of time, the disc controller chip gets very hot, and if the ambient temperature is high it can overheat and pack up altogether. It will usually function normally again when it cools down, but not always. A high working temperature will reduce the working life of an integrated circuit.

Mr Lawrence of Colchester has found similar problems with overheating and expresses concern about premature failure due to components running too hot. He has also found program crashes on his computer were due to one of the +5 volt lines reading only 4.7 volts. He suggests a self-help cure for this which involves opening up the power supply. I would strongly advise any readers against opening up the gold-coloured switching mode power supplies. They are very complex and dangerous, as rectified mains voltage can be present in many parts of the power supply. A fault here is a job for the dealer.

OWNING UP

COLIN GRANVILLE of Middlesbrough has written an excellent procedure to help in removing errors from programs that have been typed in. It automatically lists the incorrect line on a clear screen on detection of an error. Include the procedure given in listing 1 or listing 2 at the end of your program, and insert the line

ON ERROR PROCerror

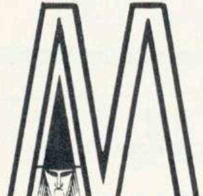
at the start of the program. Readers with Basic 1 will need to use a slightly longer routine as OSCLI is not available in Basic 1, and include the DIM statement at the start of the program:

DIM char 10

Listings 1 and 2 have a test line to show the operation of the procedure.

DIFFERENCES IN DEFAULT VALUES

MR DEAKIN of Warrington has written to suggest that in December 83's article the default value for @% of 10 was incorrect. The exact value can be found by asking the computer to PRINT ~@% at switch-on. On a micro with Basic 2 this is &90A, and on a micro with Basic 1 it is &A0A. In the *User Guide* it says the maximum number of digits that can be printed before reverting to E format is nine. This has been in-



A BBC WORD PROCESSOR TO REALLY TAKE ADVANTAGE OF YOUR DISC DRIVE.

SCRIBE is a word processor which frees the user from the limitations of computer memory. Now it is possible to create a single document with as many pages as the disc will hold. These are automatically swapped between memory and disc at the touch of a key without you even knowing it's happening. This means that your disc is being used in the way it was intended and not just as a fast cassette. Why go to the expense of buying a disc system and then use simple software really only designed for cassette?



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Plus many, many more professional features.

SCRIBE comes in ROM with five minute fitting instructions, printer utilities on disc and a comprehensive manual. (Currently recommeded for Acorn & Watford DFS)

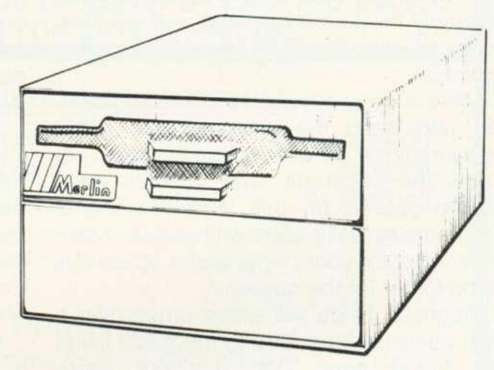
PRICE £59.95 (incl. VAT) (Post and packing 60p)

AVAILABLE SOON - a superb database to integrate with SCRIBE or to stand alone. Create over 2000 records on disc. One record equivalent to a screenful of information. Find any record in 2 seconds. Format printer output using SCRIBE. Link screens etc. etc.

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ABSOLUTE TOP QUALITY Shinon drives - aluminium chassis, head load light, band stepper motor, silent operation, latest half height dimensions. Guaranteed fully compatible with the BBC.

40 track, double density specification; systems disc containing formatting routine plus ADDBOOK - a superb disc based address book program. Create any size address file up to the maximum capacity of your disc. Also acts as a teaching example on how to write random access files. Comes with a highly comprehensive manual plus all cables and connectors. GUARANTEE ONE YEAR!



PRICE 100K single £182.50 (incl VAT) 200K dual £325.00 (incl VAT)
(Securicor delivery £8.00)

MERLIN REAL TIME CLOCK/CALENDAR

Now - highly accurate time and date continuously available on your BBC - timing not interrupted when computer is switched off.

•Battery backup, connects to user port. •Resolution 0.1 sec. •Generates interrupts 1/min, 5 sec, 0.5 sec. •Handles leap years automatically. •Day/week calendar, software included for clock display etc.

PRICE £39.95 plus VAT (Post & packing 30p)

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A superbly comprehensive version of this educational asset. This is a graphics version - each instruction controls the movement of a pen on screen. Each program produces a picture.

•Vocabulary of over 50 instructions. •20 pre-set shapes (sprites). •Printer screen dump and Program listing. •Super editor. •Colour and scale choice. •Error diagnosis. •Use variables. •Use BASIC expressions. •Show results of calculations. •Draw on compass-bearings, colour-fill, draw circles etc.

PRICE £19.95 plus VAT (Post & packing 25p)
Includes full Instruction Manual with Teaching examples.



Merlin Computer Products (Bucon Limited)

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creased to 10 with Basic 2. Using a value of @%=10 with Basic 1 works correctly, but not with Basic 2. Here @%=&90A needs to be used to keep the formatting the same as Basic 1.

Listing 3 was supplied by Mr Deakin to demonstrate the difference between the default values. In fact, the program will show a difference on a micro with Basic 2 but not on a micro with Basic 1.

```
10 REM listing 3
20 FOR A=1 TO 50
30 PRINT A/10
40 NEXT A
```

Listing 3.

A WORD TO THE WISE

HERE are a couple of simple but useful hints for users of Wordwise. Peter Helsdon of Chelmsford found a problem when trying to underline a centred heading. If the commands

f1 CE f1 OC27,45,1 f2

are used to drive a Star or Epson printer the underline starts at the beginning of the line instead of just under the heading:

HEADING

(f1 and f2 are the function keys for embedded commands).

The answer is to put a pad character between the commands as follows:

f1 CE f2 ¦ f1 OC27,45,1 f2 HEADING f1 OC27,45,0 f2

It can be a tedious task using Wordwise to locate text accurately in the desired position because the edit and preview modes have a different line-length. The following simple procedure from J Westerman of Leeds expedites matters considerably.

Before entering Wordwise, define one of the function keys (eg, KEY0) as follows:

*KEY0"0. . . . : . . . .10. . . . : . . . . 20. . . : . . . .30. . . : . . . .40. . . : . . . .50. . . : . . . .60. . . : ¦ M"

When in edit mode, simultaneous pressing of SHIFT, CTRL and f0 will print the scale. It is of most use at the bottom of the page but it can, of course, be printed or deleted as often as desired.

SPACESAVER

KEVIN WRIGHT has come up with a further saving in memory in the user defined function key buffer (see this column, *Acorn User,* November 83). Instead of entering the Basic keywords in their abbreviated

```
&B00 10 67 67 67 67 67 67 67  ........
&B08 67 67 67 67 67 67 67 67  ........
&B10 67 E8 22 45 6E 74 65 72  .."Enter
&B18 20 73 74 72 69 6E 67 3A   string:
&B20 22 4E 24 3A 50 3D 90 2B  "N$:P=.+
&B28 31 3A F5 4E 3D 32 35 36  1:.N=256
&B30 2A 50 3F 30 2B 50 3F 31  *P?0+P?1
&B38 3A 51 3D 50 2B 33 3A 50  :Q=P+3:P
&B40 3D 50 2B 50 3F 32 3A E7  =P+P?2:.
&B48 A7 24 51 2C 4E 24 29 3E  .$Q,N$)>
&B50 30 F1 4E 3A FD 50 3F 30  0.N:.P?0
&B58 3D 26 46 46 3A 8B FD 50  =&FF:..P
&B60 3F 30 3D 26 46 46  C  D  ?0=&FF..
&B68 10 10 10 10 10 10 10 10  ........
&B70 10 10 10 10 10 10 10 10  ........
&B78 10 10 10 10 10 10 10 10  ........
&B80 10 10 10 10 10 10 10 10  ........
&B88 10 10 10 10 10 10 10 10  ........
&B90 10 10 10 10 10 10 10 10  ........
&B98 10 10 10 10 10 10 10 10  ........
&BA0 10 10 10 10 10 10 10 10  ........
&BA8 10 10 10 10 10 10 10 10  ........
&BB0 10 10 10 10 10 10 10 10  ........
&BB8 10 10 10 10 10 10 10 10  ........
&BC0 10 10 10 10 10 10 10 10  ........
&BC8 10 10 10 10 10 10 10 10  ........
&BD0 10 10 10 10 10 10 10 10  ........
&BD8 10 10 10 10 10 10 10 10  ........
&BE0 10 10 10 10 10 10 10 10  ........
&BE8 10 10 10 10 10 10 10 10  ........
&BF0 10 10 10 10 10 10 10 10  ........
&BF8 10 10 10 10 10 10 10 10  ........
```

User-defined key buffer dump – compare with those in the November issue.

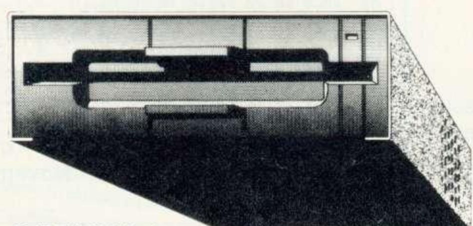
Which Disk Drive?

'Which disk drive should I choose for my BBC?'...

'Should I have a single or dual unit?'...

'Can I up-grade a single unit to a dual drive?'...

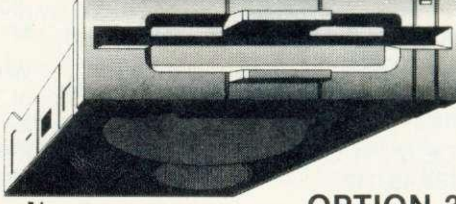
All these questions and more are now answered by the Microstyle OPTION drive. A system of disk drives designed to be flexible, cost concious and practical. If you're after a single drive choose 'OPTION 1', however, if you feel that a dual system is really the answer, but might be too costly at present choose 'OPTION 2' now and add the second drive later. 'OPTION 3' is easily installed within 'OPTION 2's' dual case at any time. As for 'OPTION 4'... well, what can we say? A superb, hi-performance dual disk system designed to expand the horizons of your BBC and to introduce you to a whole new world of computing.



OPTION 1
Single drive

100K 5¼" Single Slimline disk drive. Uses BBC power supply. Includes 'utilities disk', all leads and manual.

£185 inc VAT



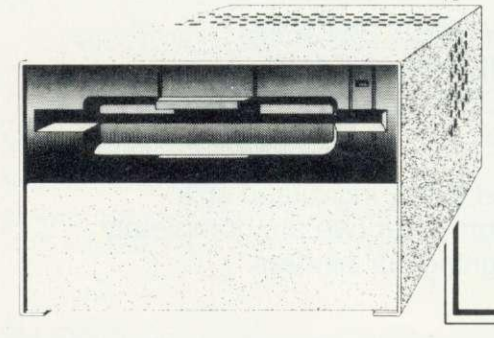
OPTION 3
Single drive to fit OPTION 2

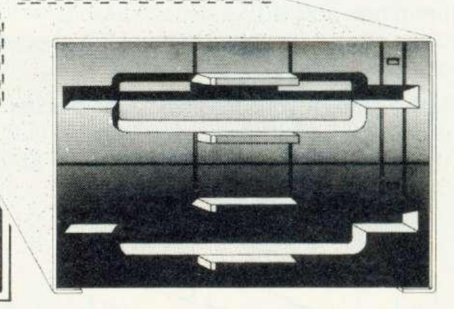
Additional single slimline disk drive, 100K turns OPTION 2 into 200K dual. (To ensure best possible results we recommend that this mod. is carried out by our own engineers.)

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Specifications

Running Current 12v 350m/A
5v 350m/A
Half height, single sided, 40 track
Unformatted capacity 250KB
Data transfer rate 250Kbit/sec
Track density .... 48 IPI
Number of tracks 40
Number of heads 1
Power on to ready .... 1 sec
Track-to-track access 6msec
Rotational speed 300rpm
Dimensions 41x146x210cm
Direct drive spindle motor
Steel band/stepper head positioning
Head load by closing door
Conventional door (like M2896)
Type: Chinon (competes with TEAC FD 55A etc.)





OPTION 2
Single drive in dual case

100K 5¼" Single Slimline disk drive, in dual case. Complete package includes 'utilities disk', all leads and manual. Own internal power supply.

£245 inc VAT



OPTION 4
Dual drive

200K dual disk drive - complete package, 'utilities disk', all leads, manual. Own internal power supply.

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...TAKE THE RISK OUT OF CHOOSING.

form, more space can be saved by entering them as the keyword tokens. Kevin has found a neat way of making the Basic interpreter do the work of converting the keywords to their tokens.

Listing 4 shows how any line of Basic can be inserted directly into the buffer using OSCLI. Listing 5 uses the command line interpreter to do the same thing for readers using Basic 1. The procedure scans the Basic program to find the line number given. It then passes this line to the function key using OSCLI (or the command line interpreter). Note that the key definitions are placed at the end of the program to ensure they are not executed during normal program running.

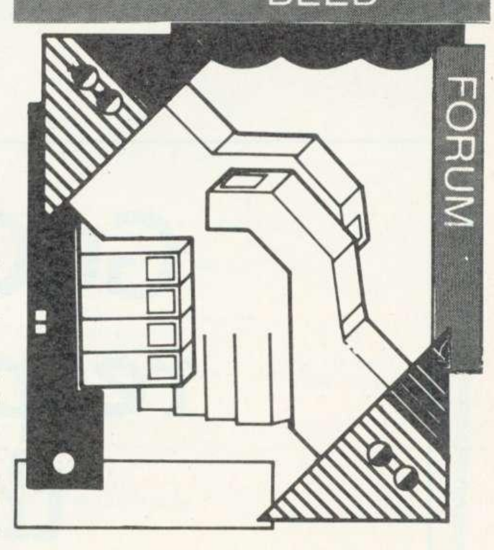
Compare this buffer dump with those presented in the earlier article. To make an exact comparison, only KEY0 has been defined. It is now only half as long as the original key definition. ●

```
   10 REM listing 4
   20 REM version for Basic 2
   30 PROCdefkey(0,2000)
   40 PROCdefkey(1,2010)
   50 END
   60
 1000 DEFPROCdefkey(number,line)
 1010 P=PAGE+1
 1020 REPEAT
 1030 N=256*P?0+P?1
 1040 Q=P+3
 1050 P=P+P?2
 1060 UNTIL N=line
 1070 OSCLI("KEY"+STR$(number)+" "+$Q)
 1080 ENDPROC
 1090
 2000 INPUT"Enter
string:"N$:P=PAGE+1:REPEATN=256*P?0+P
?1:Q=P+3: P=P+P?2: IFINSTR($Q,N$)>0
PRINTN:UNTILP?0=&FF:ELSEUNTILP?0=&FF|L|M
 2010 MODE7|MLIST|M
```

Listing 4.

```
   10 REM listing 5
   20 REM version for Basic 1
   30 PROCdefkey(0,2000)
   40 PROCdefkey(1,2010)
   50 END
   60
 1000 DEFPROCdefkey(number,line)
 1005 DIMC 256
 1010 P=PAGE+1
 1020 REPEAT
 1030 N=256*P?0+P?1
 1040 Q=P+3
 1050 P=P+P?2
 1060 UNTIL N=line
 1070 $C="KEY"+STR$(number)+" "+$Q
 1072 X%=C MOD 256
 1074 Y%=C DIV 256
 1076 CALL &FFF7
 1080 ENDPROC
 1090
 2000 INPUT"Enter
string:"N$:P=PAGE+1:REPEATN=256*P?0+P?1
:Q=P+3:P=P+P?2: IFINSTR($Q,N$)>0
PRINTN:UNTILP?0=&FF:ELSEUNTILP?0=&FF|L|M
 2010 MODE7|MLIST|M
```

Listing 5.



DISC TO TAPE TRANSFER by George Hill

A LETTER from Malcolm Andrews in the January issue of *Acorn User*, combined with my own needs, prompted program 2, the disc-to-tape copier.

Mr Andrews' need was for a method of transferring his disc programs to tape for backup purposes. Mine was to transfer chosen programs from disc to tape to send them in to the editor in an inexpensive and universally accessible form (he has 40-track discs, I have 80-track).

I followed Mr Andrews' suggestion and re-read Uncle Joe's 'Daring Deeds with Discs' article in the September 1983 issue. I modified his memory peeking program slightly, so that it gives a mode 3 screen version of any 'page' of memory. This is program 1.

I found the results of *CAT very inconvenient to use for copying purposes, as it replaces the $ directory by the space character. I used *INFO *.* instead. To see the difference between the two commands, load "PEEKMEM" (program 1), then type:

```
*CAT<CR>
RUN<CR>
```

and respond E00 to the prompt for a starting address.

You will see a copy of the catalogue in alphabetical order, but with bit 7 of the first letter of each file set (see Joe Telford's article for more detail). Thus the first letter of each filename has to be fiddled with before it can be displayed. Also the directory letters of the files are altered, so that $ (ASCII 24) is replaced by space (ASCII 20). Also the directory letter of files in the current directory has bit 7 set.

Now repeat the process using *INFO * * in place of the *CAT command. The directory is now in correct ASCII form.

In *INFO the directory letter has bit 7 set if the file is locked. Thus the commonest directory letter $ (ASCII 24) appears with bit 7 set (A4 instead of 24) on locked files. This must be corrected before display, but some fiddling with the directory letter is necessary anyway. An undesirable side-effect is that the files are not in alphabetical order when displayed this way, but in the order in which they are filed on the disc.

The program works as follows:

1. The user is asked whether he/she wants duplicate copies of each file (the editor likes two copies, in case of accidents, or bad tape blocks).
2. An invisible *INFO *.* command is issued (hidden by *FX3,2), and the catalogue information is listed on the screen, with a number (1 to 31) for each file. PROCdisplay_cat does this.
3.) The files are chosen by number, and will be saved in the order in which they are chosen. The files to be transferred are marked by a colour change (no attempt is made to stop you from choosing the same file twice). Typing ALL carries out a complete disc dump. This is all done in PROCchoose_files.
4. Each file in turn is transferred into a 'buffer' area (the whole of memory from &3000 to &7C00). OSFILE is called with A%=&FF and bytes 3 to 6 of the control block pointing to address &3000. This *LOADS the file at &3000, and transfers the load and execution addresses and the file length into the control block at the same time. It is now possible to calculate the start (&3000) and end (&3000 + length) addresses for saving and put them in the correct places in the control block. *TAPE transfers control to the tape filing system. *OPT1,0 has been selected previously, so no messages are issued, and transfer proceeds without user-intervention. A call to OSFILE with A%=0 saves the file on tape, with the original load and execution addresses preserved. This is accomplished in PROCtransfer_files. Note that files with $ directories are saved on tape without any directory letter, files with blank

page 67 ▶

IAN BIRNBAUM has, due to pressure of work, had to resign his position as 'chairman' of Beeb Forum – and he's a difficult man to replace! George Hill hosts this month's pages, and it is our aim to invite guest experts from various areas. Our thanks go to Ian for his work during the past year in establishing the Forum as an unrivalled magazine feature.

Keep the ideas – original or building on other Forums – coming, and remember, at least £5 is paid for everything printed.

PASSING ARRAYS THE SIMPLE WAY

£5

THERE is a much simpler way of passing arrays to procedures than those described in the July (page 44) and November (page 61) issues by Robin Newman. Like Robin, I wished to handle matrices in 3D transformations for perspective displays. The example (program 13) is of lines taken from a graphics program and shows how we can pass two 4 × 4 matrices A and B to a multiplication procedure, and return the product C.

The trick is that, instead of dimensioning three separate 4 × 4 matrices, we define a 4 × 4 × 3 matrix, in which the third dimension acts as an identifying digit: this is at line 70 in the example, and as usual dimensions are numbered starting from 0. The identifying digits are passed to the procedure in the usual way (as A,B,C in this example), and select the appropriate matrix as the last number of the array element identification, as Q(I,K,A) in line 2780, for example. This is possible on the BBC micro because it has no limit on the number of dimensions of an array (*User Guide*, page 236). There is one restriction in the procedure shown – you cannot write PROCMULT(A,B,A) to give an analogous result to A=A*B.

The details of the matrix multiplication are adapted from program 6.4 of Ian O Angell's book *A Practical Introduction to Computer Graphics* (Macmillan, 1981). To avoid excessive use of memory (which tends to be in short supply with 3D graphics), it is easy to re-use the identifying digits, for example:

[Define Q(X,Y,0)]
[Define Q(X,Y,1)]
PROCMULT(0,1,2) – puts the product in Q(X,Y,2)
[Redefine Q(X,Y,0)]
PROCMULT(2,0,1) – puts the new product in Q(X,Y,1)

The basic limitation of this method is that identification can only be by integer numbers, not names: but this seems a reasonable sacrifice to accept in return for simplification.

Nigel Balchin
Cambridge

```
70DIM Q(3,3,2)
........
2700DEFPROCMULT(A,B,C)
2710REM 4X4 MATRIX PRODUCT
2720REM ANGELL 6.4
2730LOCAL I,J,K,D
2740FOR I=0 TO 3
2750FOR J=0 TO 3
2760D=0
2770FOR K=0 TO 3
2780D=D+Q(I,K,A)*Q(K,J,B)
2790NEXT K
2800Q(I,J,C)=D
2810NEXT J
2820NEXT I
2830ENDPROC
```

Program 3. Passing arrays to procedures.

◀ from page 65

directories are saved with the name beginning with '.', whereas other directory letters are preserved.

5. The process is repeated until transfer is complete, or until ESCAPE is pressed (or any fatal error occurs), when the tape filing system is converted back to its normal state, and the disc filing system reselected.

Files stored on disc, although 'correctly' transferred to tape, are not readable by BGET#, as no interblock gaps are inserted (at least, I think that is the reason).

As the catalogue is read from page E (&0E00 to &0EFF), this method is not, apparently, compatible with the Watford DFS.

The transfer program will not handle files exceeding &4000 in length.

program 2 on page 69 ▶

```
   10 REM PEEKMEM
   20 REM MODIFIED FROM JOE'S DISK WORKS
PACE EXAMINER
   30 MODE3
   40 VDU14
   50 REPEAT
   60 INPUT"INPUT start address. (RETURN
 for next page) "a$
   70 IF LEFT$(a$,1)<>"&" a$="&0"+a$
   80 a=EVAL(a$)
   90 IF a<>0 THEN start=a
  100 FOR line=1 TO 32
  110 PRINT:~start;" ";
  120 FOR linepos=0 TO 7
  130 content=linepos?start
  140 IF content<&10 THEN PRINT"0";
  150 PRINT:~content;" ";
  160 NEXT
  170 PRINT"  ";
  180 FOR linepos=0 TO 7
  190 content=linepos?start
  200 ascii=(content>31 AND content<127)
  210 IF ascii THEN PRINTCHR$content: EL
SE PRINT".";
  220 NEXT
  230 PRINT
  240 start=start+8
  250 NEXT
  260 PRINT
  270 UNTIL FALSE
  280 END
```

Program 1. A mode 3 screen version of any page

£10

ECONET SPOILS THE GAME

IN THE school where I teach most of the BBC computers are fitted with the Econet interface, and we use the network fairly extensively. One problem which pupils have complained about is that many commercial games packages that are loaded into the computers by tape after selecting *TAPE and setting PAGE to &E00 are inclined to crash. I have investigated this problem, which does not occur when the same thing is tried on a machine fitted with a disk interface but no Econet interface, and believe I have found the solution, which I now offer to others who may have been frustrated by this problem.

The problem occurs because some games programs make use of locations below &E00, and in particular use page &D00. This page is normally reserved for disc or Econet NMI routines, and for a table of extended vectors which point into the ROM selected for the current filing system. (Full details of these vectors are given in the excellent *Advanced Users Guide* recently published by Cambridge Micro Centre.) The tape filing system does not make use of these vectors, and so program writers have assumed that it is OK to make use of this page when *TAPE is selected. However, the Econet ROM does maintain one vector here even when it is not selected.

If this vector is corrupted, the program will crash when the vector is accessed. Unfortunately, it appears that the vector is accessed whenever the return key is pushed in response to an input command, even if the machine is disconnected from a network. This can be shown by typing in program 5. More details of the use of this vector are given on page 260 of the *Advanced User Guide*.

However, there is a solution, which is effectively to disconnect this Econet extended vector.

In common with most filing system routines (eg, OSFILE, OSARGS, etc) this extended vector is not reached directly but via a defined vector, NETV, which is located at &224 and &225. On a non-Econet machine this vector contains &FFA6 (&A6 in &224, and &FF in &225), which points to an RTS instruction in the OS ROM. When the Econet interface is present it is altered to &FF36: ie, &224 changes from &A6 to &36. You have to alter the contents of this vector by typing ?&224=&A6 before loading the program from tape and running it. The vector can be reset afterwards by control break.

It is advisable to disconnect any machine running such games software while the program is running, as data packets received via the network may cause the machine to crash.

Type in the program and run it. Thereafter, whenever the return key is pushed in answer to an input prompt from Basic, or to terminate an input command to a program, the speaker will beep, showing that the vector at &224 (NETV) has been accessed.

The program works by redirecting the vector to point to the code at the label start. This first saves all the 6502 registers on the stack, and then outputs a beep (VDU 7), before restoring the registers from the stack and jumping to wherever the vector pointed originally. This works even if *TAPE or *DISC is selected, showing that the vector is still active. You should select the required filing system before running the program.

```
 10 REM VECTOR: demonstrates the
 20 REM pervading effect of the Econet
 30 REM vector at &224,&225!
 40 REM
 50 REM Push BREAK to reset
 60 vec=&224:vecold=&70:oswrch=&FFEE
 70 DIM code 50
 80 FOR Z%=0 TO 2 STEP 2
 90 P%=code
100 [OPT Z%
110 LDA vec:STA vecold:LDA vec+1:STA vecold+1
120 LDA#start MOD256:STA vec:LDA #start DIV256:STA vec+1
130 RTS
140 .start PHP:PHA:TXA:PHA:TYA:PHA
150 LDA#7:JSR oswrch
160 PLA:TAY:PLA:TAX:PLA:PLP
170 JMP(vecold)
180 ]:NEXT
190 CALL code
200 PRINT"Now that the program is running"
210INPUT"type in any input..."A$
220PRINT'"The beep shows the vector was used!"
```

Program 4.

Robin Newman
Peterborough



BEEBUG FOR THE BBC MICRO

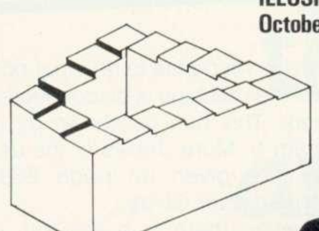
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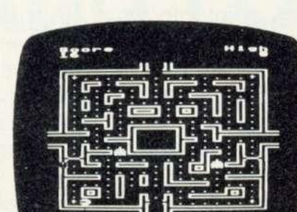
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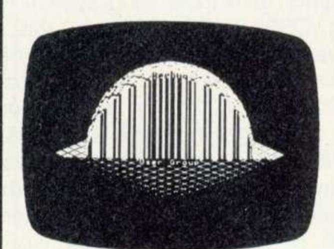
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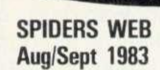
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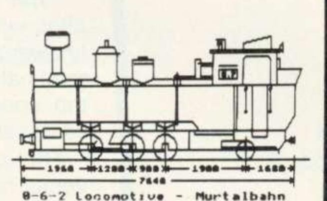
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◀ *from page 67*

Program 2. Disc-to-tape copier

```
   10 REM D_T
   20 REM DISC TO TAPE COPIER
   30 REM G.B.HILL (c) JANUARY 1984
   40
   50 MODE7
   60 HIMEM=&3000
   70 ON ERROR REPORT:PRINT" at line ";ERL:GOTO 140
   80
   90 PROCset_up
  100 PROCone_or_two
  110 PROCdisplay_cat
  120 PROCchoose_files
  130 PROCtransfer_files
  140 *TAPE
  150 *OPT1,1
  160 *DISC
  170 END
  180
  190 REM *** PROCEDURES ***
  200
  210 DEFPROCone_or_two
  220 PRINTTAB(0,3)"One copy of each file, or two?"''"Type 1 or 2 ";
  230 REPEAT:Z=GET:UNTIL Z=49 OR Z=50
  240 IF Z=50 THEN two_copies=TRUE ELSE two_copies=FALSE
  250 CLS
  260 ENDPROC
  270
  280 DEFPROCset_up
  290 *TAPE
  300 *OPT 1,0
  310 *DISC
  320 DIM N(31)
  330 DIM block 17
  340 DIM name 8
  350 X%=block MOD 256
  360 Y%=block DIV 256
  370 block?0=name MOD 256
  380 block?1=name DIV 256
  390 osfile=&FFDD
  400 buffer=HIMEM
  410 ENDPROC
  420
  430 DEFPROCdisplay_cat
  440 *FX3,2
  450 *INFO *.*
  460 *FX3,0
  470 file_number=0
  480 REPEAT
  490 file_number=file_number+1
  500 name_start=&E00+8*file_number
  510 end_of_cat=(?name_start=0 OR file_number=32)
  520 IF NOT end_of_cat THEN PROCdecode_name(file_number):PROCprint_name(file_number,FALSE)
  530 UNTIL end_of_cat
  540 number_of_files=file_number-1
  550 ENDPROC
  560
  570 DEFPROCdecode_name(fn)
  580 dir=?(&0E07+8*fn)
  590 dir=dir AND &7F
  600 N$=CHR$dir+"."
  610 name_start=&0E00+8*fn
  620 FOR n=0 TO 6
  630 ch$=CHR$(name_start?n)
  640 IF ch$<>" " THEN N$=N$+ch$
  650 NEXT
  660 ENDPROC
  670
  680 DEFPROCprint_name(fn,save_it)
  690 x=20*((fn-1) DIV 16)+1
  700 y=1+((fn-1) MOD 16)
  710 IF save_it THEN PRINTTAB(x-1,y);CHR$131;TAB(x+15,y);CHR$135 ELSE PRINTTAB(x,y);N$;TAB(x+11,y);fn
  720 ENDPROC
  730
  740 DEFPROCchoose_files
  750 *FX15,1
  760 LOCAL I
  770 PRINTTAB(0,18);"Type in the numbers of the files you"'"wish to transfer to tape."
  780 PRINTTAB(0,20);"Type ALL for complete disc save"'"and press RETURN to start transfer."
  790 I=0
  800 REPEAT
  810 number_to_save=I
  820 I=I+1
  830 INPUTTAB(0,22)file_number$
  840 IF file_number$="ALL" THEN PROCall
  850 file_number=VALfile_number$
  860 done=(file_number=0)
  870 OK=(file_number>=0 AND file_number<=number_of_files)
  880 PRINTTAB(0,22)"          ";
  890 IF NOT OK THEN VDU7:GOTO 830
  900 IF NOT done THEN N(I)=file_number:PROCprint_name(file_number,TRUE)
  910 UNTIL done
  920 ENDPROC
  930
  940 DEFPROCall
  950 FOR I=1 TO number_of_files
  960 N(I)=I
  970 NEXT
  980 number_to_save=number_of_files
  990 ENDPROC
 1000
 1010 DEFPROCtransfer_files
 1020 LOCAL I
 1030 CLS
 1040 IF number_to_save=0 THEN PRINTTAB(0,3)"Silly - can't transfer no files!":ENDPROC
 1050 PRINTTAB(0,3)"Press RECORD then RETURN"
 1060 REPEAT:UNTIL GET=13
 1070 FOR I=1 TO number_to_save
 1080 CLS
 1090 PRINTTAB(0,3);number_to_save;" files to transfer - now on number ";I
 1100 PROCdecode_name(N(I))
 1110 *DISC
 1120 IF LEFT$(N$,1)="$" OR LEFT$(N$,1)=" " THEN save_name$=RIGHT$(N$,LEN(N$)-2) ELSE save_name$=N$
 1130 IF LEFT$(N$,1)=" " THEN save_name$="."+save_name$
 1140 $name=N$+CHR$13
 1150 A%=&FF
 1160 block!2=buffer
 1170 block?6=0
 1180 PRINTTAB(3,6);CHR$131;"LOADING   ";CHR$135;N$;CHR$131;" FROM DISC   "
 1190 CALLosfile
 1200 *TAPE
 1210 $name=save_name$+CHR$13
 1220 block!&0E=(buffer+block!&0A)
 1230 block!&0A=buffer
 1240 A%=0
 1250 PRINTTAB(8,6);"ED AS"
 1260 PRINTTAB(3,8);CHR$134;"SAVING AS ";CHR$135;save_name$;CHR$134;" ON TAPE  "
 1270 IF two_copies THEN PRINTTAB(3,10)"First copy "
 1280 CALLosfile
 1290 IF two_copies THEN PRINTTAB(3,10)"Second copy":CALLosfile
 1300 NEXT
 1310 CLS
 1320 PRINTTAB(0,3);CHR$133;"TRANSFER COMPLETE"'';CHR$133;"Press";CHR$135;"STOP";CHR$133;"button."
 1330 ENDPROC
```

THROUGH THE SOUND BARRIER

Commander Bruce Smith gives the order for some special effects that will make your bold interstellar exploits go with a bang

WHAT interstellar venture would be complete without at least a few reverberations on the Beeb's internal speaker as a Photon torpedo slides away from the *SS Hermaria*, devastating the Sinclaronian fighter winking in the distance of the mode 4 screen? And all starships need to warp into hyperspace at some time, so a whoosh or two is an absolute must.

How do we go about producing these much sought after effects? The most obvious way it to use Basic's versatile SOUND and ENVELOPE commands, but at some stage you'll want to use the mnemonic assembler to create special super-fast graphics effects not possible within the constraints of an interpreted language – even one as fast as the BBC micro's Basic. So in this article we'll examine how to produce these two Basic commands in machine code.

To make life easier two OSWORD calls are included in the MOS to enable us to generate a sound and define an envelope. To select the appropriate call, the accumulator must contain the correct OSWORD call code, 7 for SOUND and 8 for ENVELOPE. The X and Y registers should contain the low and high bytes respectively of the address of a parameter block which contains all the information required by either routine.

To generate a sound the OSWORD routine expects to find eight data bytes in the parameter block, which it treats as four double-byte values, giving:

Byte 0 – Channel	low byte
Byte 1 – Channel	high byte
Byte 2 – Amplitude	low byte
Byte 3 – Amplitude	high byte
Byte 4 – Pitch	low byte
Byte 5 – Pitch	high byte
Byte 6 – Duration	low byte
Byte 7 – Duration	high byte

If you are familiar with the SOUND statement you will realise that these parameters are similar to those used in Basic and you may not be surprised to learn that exactly the same effect is produced. Consider the statement SOUND 1,-15,100,20. To produce this in machine code we need only place the relative bytes, as two-byte numbers, into the parameter block and perform the OSWORD call. The only awkward point here is the representation of -15 as a two-byte value. To do this we need to obtain its 'two's complement' value, which is the usual way of writing a negative number in binary form. First write 15 as a two-byte binary number, invert all the bits and then add 1 to derive the two's complement:

```
15                00000000 00001111
invert the bits   11111111 11110000
now add 1 to this value to get the two's
complement
                  11111111 11110000
                + 00000000 00000001
                  -----------------
-15               11111111 11110001
                  -----------------
```

Converting this to hex we have &FFF1. Program 1 produces the sound defined above. A macro has been used in lines 60 to 110 to generate the necessary code. Basic's MOD and DIV functions are used to obtain the low- and high-byte address of the parameter block that is placed into the index registers. Note the use of the hash '#' to indicate immediate addressing in lines 80, 140 and 150; this is quite often omitted and a frequent cause of frustration during debugging.

An envelope can be defined in a similar manner. However the parameter block should now be 14 bytes long, containing all the usual information required by a Basic ENVELOPE definition, and again a macro can be incorporated into the program to assemble the machine code. Programs 2, 3 and 4 illustrate the technique.

Now for some useful routines that you might incorporate into your own programs. Program 2 provides *Defender*-type laser fire when run. The envelope definition is taken care of by lines 80 to 240. The envelope data is incorporated into the DATA statement of line 240 and is the direct Basic equivalent of:

ENVELOPE 1,129,-15,-8,-3,10,10,10,126,0,0,-126,126,126

As before, the negative values -15, -8, -3 and -126 are represented as single byte two's complement values. On running, a zap will be provided every time a key is pressed. By incorporating an OSBYTE &81 call – more affectionately known as INKEY in Basic – a particular key can be detected and used to act as a fire button.

Program 3 provides a blast-off or hyperdrive sort of sound. The program is similar in many respects to program 2 for ENVELOPE and SOUND definitions. In this instance, however, the third SOUND parameter defining the note's pitch is incremented inside a loop (lines 400 to 460) to produce the increasing roar of the Starship's engines. By rearranging the loop to provide a decrementing pitch the craft can be made to land.

Program 4 is an absolute must and has probably been used on more space-orientated games than any other tunes – if you can't guess what it is from by the introductory REM statements then I'm certain you'll recognise the tune itself. Good hunting! ●

Program 1.

```
10 REM ** SOUND 1,-15,100,20 **
20 osword=&FFF1
30 parameter=&70
40 P%=&1800
50 [.sound :] : REM mark start of code
60 FOR loop=0 TO 7
70 READ byte
80  [ lda #byte          \ get read byte
90    sta parameter+loop  \ and save it
100  ]
110 NEXT loop
120 [ \ set up osword call
130   lda #7         \ osword call is number 7
140   ldx #parameter MOD 256
150   ldy #parameter DIV 256
160   jmp osword   \ call osword and back to BASIC
170 ]
180 DATA 1,0,&F1,&FF,100,0,20,0
190 REM   1 ,  -15  ,  100  ,  20
200 CALL sound
```

►page 73

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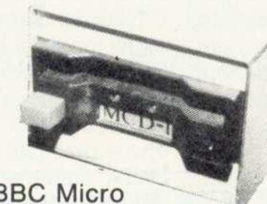
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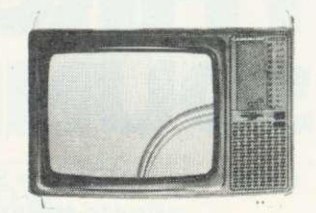
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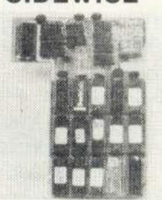


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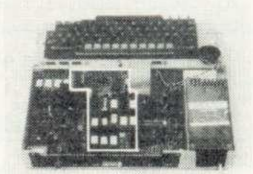
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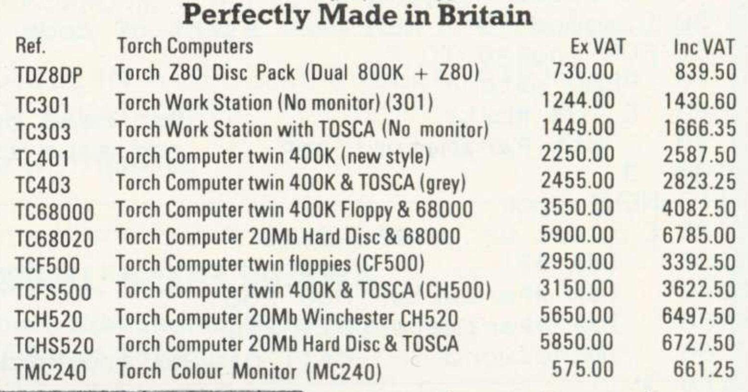
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Program 2. 'Defender'-type laser fire

```
 10 REM ** ZAP DEM ALIENS **
 20 REM ** using OSWORD calls
to perform **
 30 REM ** ENVELOPE and SOUND
commands **
 40 osword=&FFF1
 50 env_param=&70
 60 sou_param=&80
 70 P%=&1800
 80 [.envelope \ define envelope
 90 ]
100 FOR loop=0 TO 13
110 READ byte
120 [
130 lda #byte \ get read byte
140 sta env_param+loop
150 ]
160 NEXT loop
170 [ lda #8  \  osword code
180 ldx #env_param MOD 256
190 ldy #sou_param DIV 256
200 jsr osword
210 rts
220  ]
230 REM ENVELOPE DATA
240 DATA 1,129,&F1,&F8,&FD,10,
10,10,126,0,0,&82,126,126
250 [.sound  \  define sound
260 ]
270 FOR loop=0 TO 7
280 READ byte
290 [
300 lda #byte  \  get READ byte
310 sta sou_param+loop
320 ]
330 NEXT loop
340 [ lda #7  \  osword code
350 ldx #sou_param MOD 256
360 ldy #sou_param DIV 256
370 jsr osword
380 rts
390 ]
400 REM SOUND DATA
410 DATA &11,0,1,0,255,0,5,0
420 CALL envelope
430 REPEAT
440  CALL sound
450  CALL &FFE0
460 UNTIL 0
```

Program 3. Blast-off or hyperdrive sound

```
 10REM ** UFO BLASTOFF **
 20REM ** using OSWORD calls
to perform **
 30REM ** ENVELOPE and SOUND
commands **
 40osword=&FFF1
 50env_param=&70
 60sou_param=&80
 70P%=&1800
 80[.envelope \ define envelope
 90]
100FOR loop=0 TO 13
110READ byte
120[
130lda #byte \ get read byte
140sta env_param+loop
150]
160NEXT loop
170[ lda #8  \  osword code
180ldx #env_param MOD 256
190ldy #sou_param DIV 256
200jsr osword
210rts
220 ]
230REM ENVELOPE DATA
240DATA 1,1,6,6,6,2,2,1,126,
0,0,&82,126,126
250[.sound  \  define sound
260]
270FOR loop=0 TO 7
280READ byte
290[
300lda #byte  \  get READ byte
310sta sou_param+loop
320]
330NEXT loop
340[.ufo
350lda #7  \  osword code
360ldx #sou_param MOD 256
370ldy #sou_param DIV 256
380jsr osword
390rts
400.blastoff
410jsr ufo
420ldx &84
430inx
440stx &84
450cpx #220
460bne blastoff
470rts
480]
490REM SOUND DATA
500DATA 1,0,1,0,0,0,1,0
510CALL envelope
520CALL blastoff
```

►page 74

◀ from page 73

```
 10 REM **   DA, DA, DA ,DA ,DAR!   **
 20 REM ** Close Encounters of the **
 30 REM **      Acorn kind!         **
 40 osword=&FFF1
 50 sound=&1500
 60 P%=&1800
 70 [ .contact : ]
 80 FOR outer=0 TO 14
 90  FOR inner=0 TO 7
100   READ byte
110    [
120     lda #byte          \ get read byte
130     sta sound+inner    \ and save it
140    ]
150  NEXT inner
160  [
170  lda #7                \ osword code
180  ldx #sound MOD 256
190  ldy #sound DIV 256
200  jsr osword
210  ]
220   sound=sound+7
230 NEXT outer
240 [ \ and now back to you basic
250    rts
260 ]
270 CALL contact
280 DATA 1,0,&F1,&FF,97,0,10,0
290 DATA 2,0,&F2,&FF,98,0,10,0
300 DATA 3,0,&F3,&FF,96,0,10,0
310 DATA 1,0,&F1,&FF,105,0,10,0
320 DATA 2,0,&F2,&FF,106,0,10,0
330 DATA 3,0,&F3,&FF,104,0,10,0
340 DATA 1,0,&F1,&FF,89,0,10,0
350 DATA 2,0,&F2,&FF,90,0,10,0
360 DATA 3,0,&F3,&FF,88,0,10,0
370 DATA 1,0,&F1,&FF,41,0,10,0
380 DATA 2,0,&F2,&FF,42,0,10,0
390 DATA 3,0,&F3,&FF,40,0,10,0
400 DATA 1,0,&F1,&FF,69,0,20,0
410 DATA 2,0,&F2,&FF,70,0,20,0
420 DATA 3,0,&F1,&FF,68,0,20,0
```

Program 4. It's that tune again!


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SCROLL OF HONOUR

WHEN we ran the Micro Gallery Competition in the November issue, little did we know the results would turn out to be slightly embarrassing. Two of the three winners have written for *Acorn User*, and the third is the author of Beeb-Art!

However, these were hardly reasons for disqualification, and the three judges were unanimous in their choice of winner, with majorities on the other two places.

Among the entries as a whole, craft was far more in evidence than art. Copies of pictures made up the vast majority of entries – from David Bowie as pictured on the cover of his album *Aladdin Sane* to *The Lady of Shalott* by John William Waterhouse (you can see the original in the Tate Gallery). Engineering drawings or diagrams were the next most common type of entry. Only one person made use of any form of animation (a flashing ray gun on a War of the Worlds machine).

Now down to awarding the gongs.

Dave Mendes rolled in at number three . . . using his own package. His version of the famous BBC micro advert was used on the packaging for Beeb-Art. This picture is an excellent demonstration of the software, and, said one judge, would have made a better advertising picture than the original. Dave wins £10 worth of software.

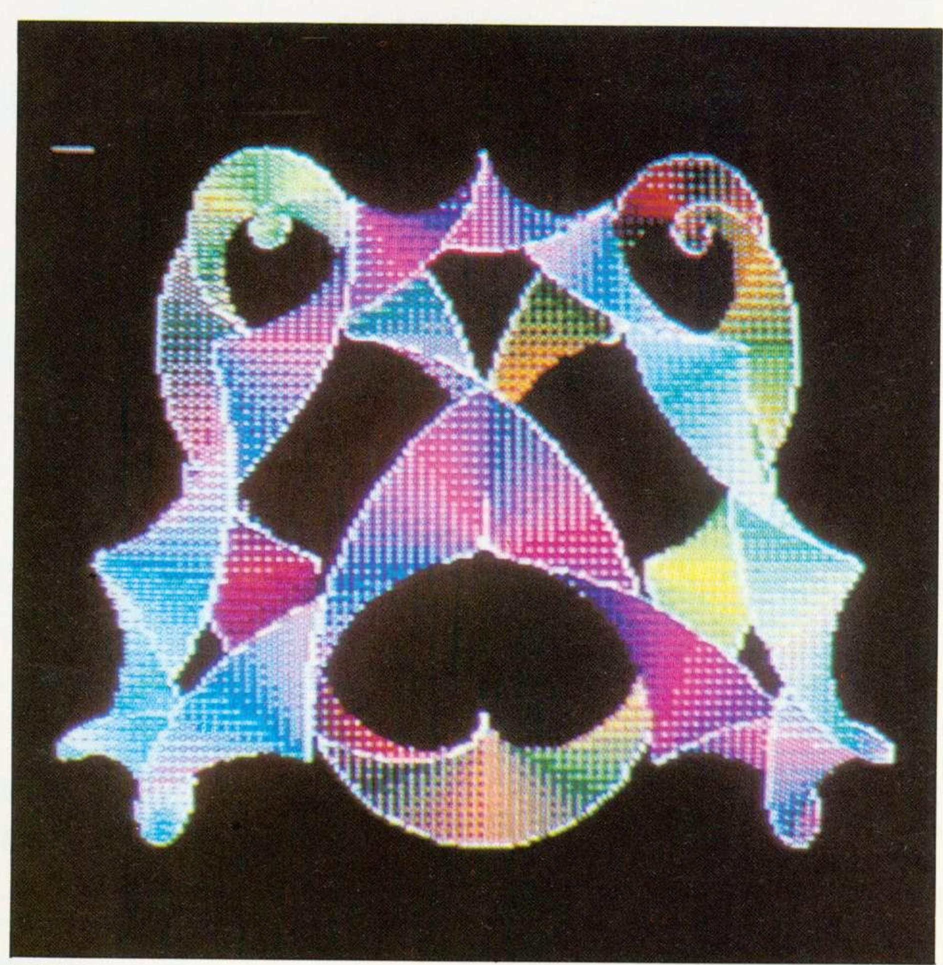
Second prize (£20) went to one of our reviewers, Alan Pipes, for his *After Kandinsky (Swinging 1925)*. Salamander's EDG software produced a very good interpretation of the original, the vivid colours giving a fascinating layered effect.

Pride of place – and £30 worth of software – went to Malcolm Banthorpe for *Abstract Scrolls* (our title). One comment during the judging session was prophetic: 'He obviously has a feel for geometry'. Malcolm went on to write the two articles on Life, including the 3D version in this issue.

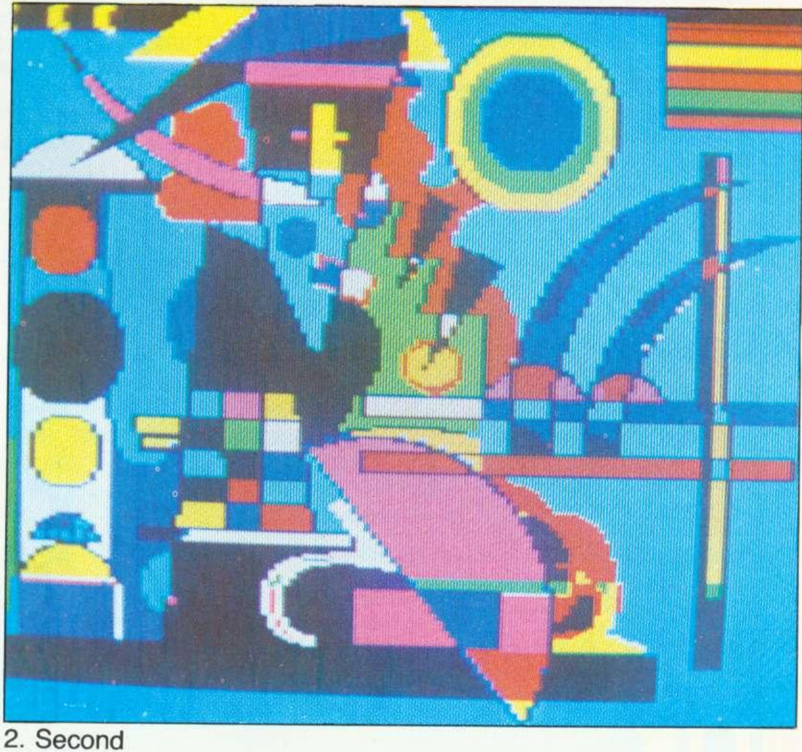
The colours on *Scrolls* were produced using the Gaelsett ECFG program, and the basic design was created using the author's own software.

Micro Gallery was judged by Robin Mudge, who worked on both BBC TV computer series and is now directing the new series on control, Phil Kanssen, *Acorn User*'s art editor, and Tony Quinn, editor. Our thanks to Quicksilva and Acornsoft for sponsoring the competition.

Entries for the next Gallery should be sent to *Acorn User* at 53 Bedford Square, London WC1B 3DZ. Please send either a transparency, or a cassette/disc, with an SAE if the entry is to be returned. Don't forget to explain how the picture was created. The judging criteria are artistic content and technical excellence (just like ice-skating). Three prizes of software will be awarded worth £30, £20 and £10.



1. First



2. Second


3. Third

1. First: 'Abstract Scrolls' by Malcolm Banthorpe. Originality and artistic content made it a unanimous choice. Drawn using the author's own program and the ECFG software

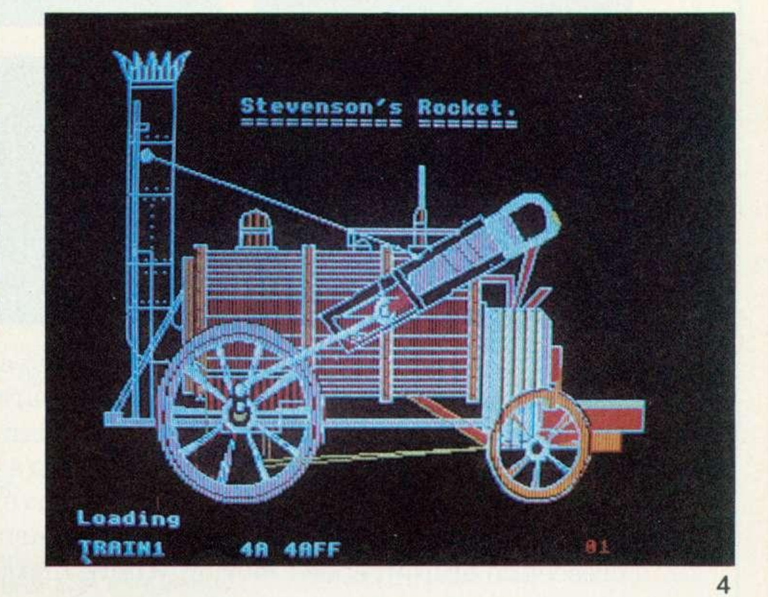
2. Second: 'After Kandinsky (Swinging 1925)' by Alan Pipes. Salamander's EDG software used to give layered colour effect

3. Third: 'Micro Advert' by Dave Mendes using his Beeb-Art package distributed by Quicksilva. Better than the original?

4. 'Rocket' by C Rohsler. The best of the diagram-type entries. Drawing package by AB Designs put to good use

5. 'The Lady of Shalott' after John William Waterhouse, by David Mendes. Good use of colour using Beeb-Art

6. 'Bowie' by L Childs. Striking effect produced using the BBC micro's built-in commands only (0.1 OS)



4


5


6

LEARN LISP

Stan Froco presents a three-part series that will set you on the road to mastering one of the most powerful computer languages. The articles focus on the use of Lisp on the BBC micro and Electron, and assume that the Acornsoft implementation will be used. This introductory article emphasises the practical aspects of the language but, like the others, presents a complete program

IN THIS series I hope to interest three groups of people: those with a general interest in computing who wish to know more about one of the most important languages in computer science over the last 25 years; those who have a BBC micro and wish to know more about Lisp before buying a copy; and those who already own Lisp for the BBC micro and wish to know more about it. I hope by the end of the series these last two groups will feel confident of their ability to program problems in Lisp, and, more important, that for many problems it is the most suitable language to use. Lisp is a valuable addition to the toolkit of the modern programmer.

Lisp is one of the oldest computer languages still in widespread use. It was developed around 1960 by John McCarthy and others at the Massachusetts Institute of Technology, just after Cobol appeared (1958). Not until later did languages like Algol (1960-62) and Fortran IV (1966) appear. Yet despite its age Lisp is now used more than ever before, and has become the leading language in Artificial Intelligence research.

The language has evolved over the years from McCarthy's rather inflexible Lisp 1.5. A number of dialects have developed around the world all based on the same basic ideas. The Acornsoft implementation, which I shall use throughout for my examples, is perhaps nearest to the approach used in the Cambridge Lisp system developed by Arthur Norman and John ffitch. The slight differences should not worry the user. Changing between systems is not usually difficult.

This series cannot cover every detail of Lisp, particularly for those actually learning to program in the language – they will need a reference book. The book to use (at least with the Acornsoft implementation) is *LISP on the BBC Microcomputer* by Arthur Norman and Gillian Cattell, published by Acornsoft. It is also suitable for the Electron – just read 'Electron' for 'BBC microcomputer' throughout. I shall attack Lisp from a slightly different angle, but the end result is the same, and two different slants on the same subject should help clarify the underlying concepts.

For those wishing to pursue Lisp further, possibly even to using large mainframe versions, I can recommend *Artificial Intelligence Programming* by Charniack, Riesbeck and McDermott, published by Lawrence Erlbaum Associates. This is a good general book on the practical aspects of using the language, although it is sometimes difficult to acquire in this country.

Lisp is an applicative language. It works by applying functions to values and getting results back. We are used to writing function applications in Basic such as:

```
Log (10)
CHR$ (65)
```

These return values of 1 and 'A' respectively. We could also write the ordinary arithmetic operators as functions. For instance:

```
2 + 3
```

could be written as

```
PLUS (2, 3)
```

This isn't particularly useful, and so Basic doesn't provide a built-in PLUS function.

'. . . A valuable addition to the toolkit of the modern programmer'

In Lisp only functions are allowed, and so we have to do everything as functions. Here are some items of Basic:

```
i) A = 32
ii) 3 + 5
iii) 2 + 3 * 4
iv) PRINT "HELLO"
```

Here are the same items written as functions (the funny names will be explained as we go on):

```
i) SETQ (A, 32)
ii) PLUS (3, 5)
iii) PLUS (2, TIMES (3, 4))
iv) PRINTC ("HELLO")
```

i) and iv) are a little different. While it is clear that ii) gives a result 8 and iii) gives a result 14, it is not clear what result SETQ and PRINTC will return. Their usefulness lies in that returning a result, as all functions must (and what that result is we shall see later), they have side-effects. The side-effect of SETQ is that it sets a variable, and the side-effect of PRINTC is that it prints something out.

Lisp uses a slightly different notation for its functions. Instead of:

```
PLUS (1, 2)
```

we write

```
(PLUS 1 2)
```

Since everything in Lisp is based on evaluating (or calling) functions, Lisp chooses to surround the whole function call in brackets, indicating that this is the basic unit of operation. In general:

```
(f a b c ...)
```

means a function f called with arguments a, b, c, ... Notice how Lisp uses spaces to separate items rather than commas.

In fact, the arguments to a function need not be numbers but can be function calls themselves. For instance, we saw earlier how:

```
2 + 3 * 4
```

can be written (using Lisp notation) as

```
(PLUS 2 (TIMES 3 4))
```

Before evaluating PLUS, Lisp evaluates its arguments by calling the TIMES function. This then leaves:

```
(PLUS 2 12)
```

which in turn will give a value 14 as a result. You can nest functions as deeply as you like. Lisp always starts by evaluating the innermost expressions first.

You may wonder how Lisp copes with expressions that in conventional notation need brackets, for example:

```
(2 + 3) * 4
```

Brackets are not needed in Lisp to express this (a good thing, since they're already being used to delimit function calls). The meaning is made clear by writing:

(TIMES (PLUS 2 3) 4)

The order of function nesting is used instead of brackets to make the order of evaluation clear. Lisp will start with the innermost function (PLUS 2 3) and evaluate that first. The rule is that things in brackets in conventional notation go into the innermost function call within a Lisp expression.

Now is the time to take your Lisp system, if you are using one, and experiment. Lisp

'Lisp has become the leading language in Artificial Intelligence'

is started up by

CHAIN ""

for tape,

SHIFT/BREAK

for disc, and

*LISP

for ROM

The Lisp system loads, relocating to make the maximum memory available for your machine and eventually comes up with the prompt:

Evaluate:

Try typing in:

(PLUS 10 32)

The system will respond with:

Value is: 42
Evaluate:

Try typing functions for evaluation and see what you get. You can find what functions and variables Lisp knows about by using the function call:

(OBLIST)

Let us return to the functions SETQ and PRINTC mentioned earlier.

(SETQ A 10)

is used to set the variable A to have the value 10. Now we could say:

(PLUS A 5)

and back would come the result:

15

If you try using (SETQ A 10) you will see that it does return a value, 10. This is extremely useful for setting several variables at once. In Basic we cannot write:

A = B = C = 10

However, in Lisp we just write:

(SETQ A (SETQ B (SETQ C 10)))

The PRINTC functions prints things out, for example:

(PRINTC A)

would print out the value 10, if we had just used the SETQ above to give the variable A a value of 10. The reason for calling the function PRINTC rather than PRINT will be explained in the next article (if you play around you may be able to work out what the difference is). We can also use PRINTC to print out text. For example:

(PRINTC 'HELLO)

would print out HELLO. Note that we use a single preceding quote before the text, rather than the enclosing pair of double quotes used in Basic. Lisp prints out all the characters after the ' until it encounters one of

' ( ) . space

Printing these characters out is rather difficult. A way of printing spaces will be given later, and a general technique for printing special characters in the next article.

Textual items can be used as values in Lisp, just as numbers can be. Thus we can say

(SETQ A 'FRED)
(PRINTC A)

to print out the value FRED. PRINT is one of a number of functions in Lisp that can take any number of arguments (PLUS is another). For example:

(PRINTC 'THE 'CAT 'SAT 'ON 'THE 'MAT)

This doesn't have quite the right effect. What gets printed out is

THECATSATONTHEMAT

Fortunately, Lisp provides a variable, BLANK, whose value is the space character, and this gets round the problem of textual items not having space characters in them. We could use:

(PRINTC 'THIS BLANK 'IS BLANK 'BETTER)

to print out

THIS IS BETTER

If you have been experimenting you may by now have realised that PRINTC returns as its value the last item it printed. Thus in the above example it would return the textual item BETTER. This can prove useful for following what is going on. For instance, if we wanted to check what value was being given to the variable Z in a program we could do so by replacing each occurrence of:

(SETQ Z ...)

by:

(SETQ Z (PRINTC 'Z= ...))

We now have a good idea of how functions can be used in Lisp. In a while I'll describe more functions with which we can build up programs. First, however, we need to consider how Lisp programs handle data.

If you are experimenting while reading this next section, don't forget you can always find the value of a variable by typing its name when you get the evaluate prompt. Not surprisingly, the value of a Lisp variable when evaluated is its value.

The fundamental building block in a Lisp program is the *list*. Indeed, Lisp stands for *L*ist *P*rocessing Language. A list is just a sequence of items, separated by spaces and enclosed in brackets. For example:

(1 2 4 8 16 32)
(This is a sentence)

Lisp provides facilities for manipulating lists, changing their contents and structure. One of the reasons Lisp is so popular for natural language processing is that lists are a very useful way of representing sentences.

Lists can be as complex as you like. Here is a list of lists

((The first clause) (The second clause) (The last clause))

We have, in fact, already seen some lists:

(PLUS 1 2)
(SETQ A 'FRED)
(PRINTC 'HELLO)

Here we have a fundamental property of Lisp. Its programs and data are identical in structure. We can have programs that modify programs. This is why Lisp is so useful in the field of formal verification of software. Programs in Lisp can easily be manipulated and hence (relatively) easily analysed and verified.

The normal action of the Lisp system when presented with a list is to try to evaluate it. Thus, if I want to use lists as data I have a slight problem – the system assumes they're programs (ie, functions for evaluation) and tries to evaluate them.

Suppose I wish to give the variable B the list

(THE FAT CAT)

as its value. I could try:

(SETQ B (THE FAT CAT))

'In Lisp you can nest functions as deeply as you like'

However, this will merely cause an error-expression in function position not a function. The system has tried to evaluate

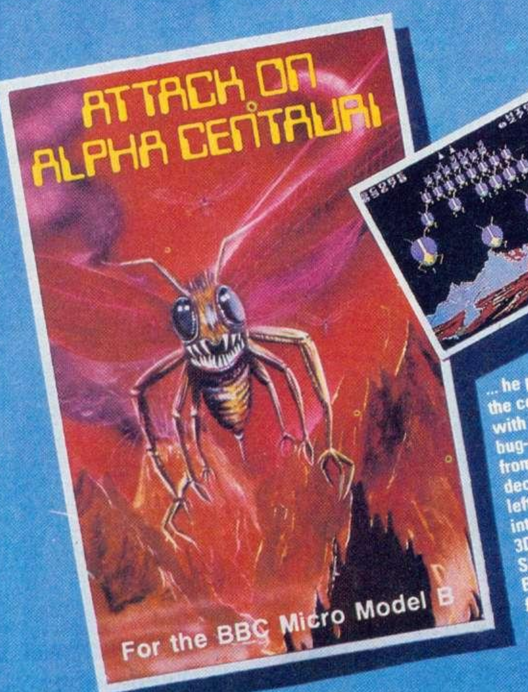
(THE FAT CAT)

and has discovered that there is no function THE. This is perfectly reasonable. Consider the following almost identical expression:

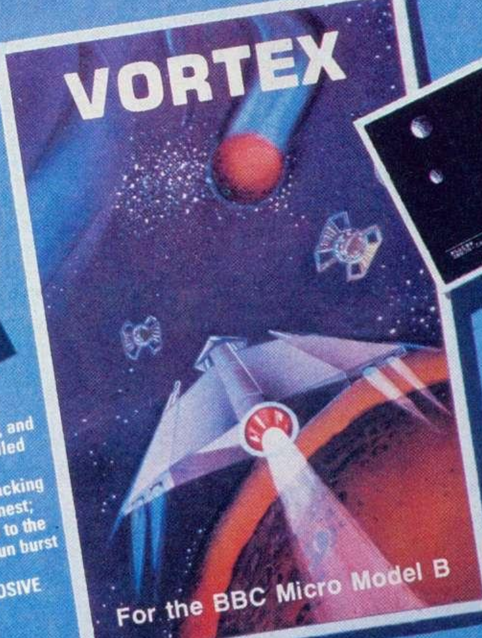
(SETQ B (TIMES 2 2))

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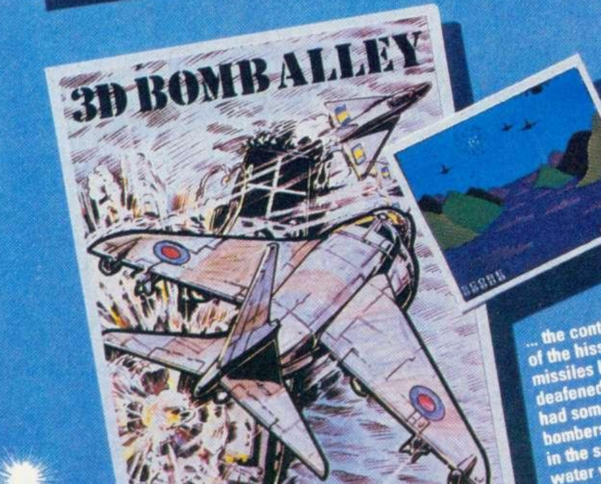
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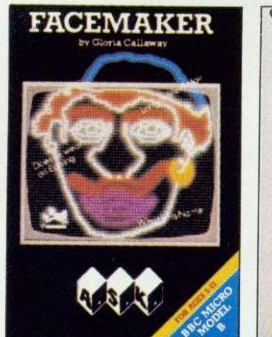
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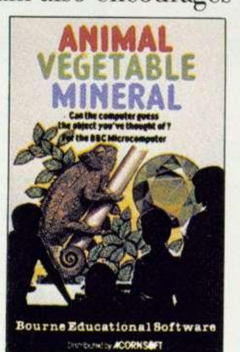
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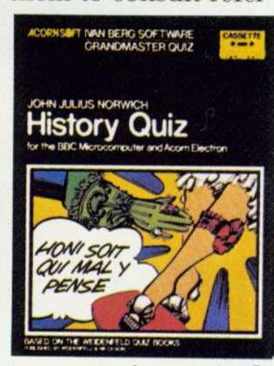
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Presumably, we wish B to end up having the value 4, not the list (TIMES 2 2). There are two solutions. Lisp provides a function LIST which will build a list from its arguments. We could then use:

```
(SETQ B (LIST 'THE 'FAT 'CAT))
```

Notice how we put quotes in front. We don't want a list of the values of the variables THE, FAT and CAT, but a list of the three textual items. For example:

'A single quote really means don't evaluate the expression following'

```
(PRINTC B)
```

will now print out

```
(THE FAT CAT)
```

Another way is to use a generalisation of the quote symbol. A single quote really means don't evaluate the expression following. If applied just to a single string of letters this just gives us the textual item, otherwise we will get the list structure following the quote preserved. So we could have used:

```
(SETQ B '(THE FAT CAT))
```

Notice the difference from LIST – nothing inside the brackets is evaluated. If we did want something evaluated then we would have to use LIST. For instance, consider:

```
(SETQ X 5)
(SETQ Y 10)
(SETQ Z 15)
```

then

```
(SETQ B '(X Y Z)
```

would give B the value

```
(X Y Z)
```

and

```
(SETQ B (LIST 'X 'Y 'Z))
```

would also give B the value

```
(X Y Z)
```

but

```
(SETQ B (LIST X Y Z))
```

would give B the value

```
(5 10 15)
```

Try to build some lists and see what you get.

There are three basic functions for manipulating lists.

```
(CAR x)
```

will give the first item of the list x. For example:

```
(CAR '(THIS IS A SENTENCE))
```

gives as result the textual item

```
THIS
```

Conversely

```
(CDR x)
```

will give all but the first item of the list x. For example:

```
(CDR '(THIS IS A SENTENCE))
```

gives as result the list

```
(IS A SENTENCE)
```

The opposite is

```
(CONS a x)
```

This appends item a on to the head of the list x. For example:

```
(CONS 'A '(NEW SENTENCE))
```

gives

```
(A NEW SENTENCE)
```

You can probably see that

```
(CONS (CAR x) (CDR x))
```

gives a list that is identical to x.

There is one special list. This is the empty list

```
()
```

This is referred to by the special name NIL, and obviously it is not sensible to ask for the CAR or CDR of this list.

We now have most of the functions we need to write programs in Lisp. I wish to consider just one or two more, before I show a short example program.

Lisp has an equivalent of the IF...THEN...ELSE construct in Basic that is rather more powerful. It is the function COND which has the general form:

(COND
  (condition$_1$ function-call(s)$_1$)
  (condition$_2$ function-call(s)$_2$)
  .
  .
  .
  (condition$_n$ function-call(s)$_n$))

Notice how I spread the expression over several lines – the system knows when I have finished because there are a matching number of brackets.

The conditions are functions or variables which return values true or false. Lisp has a rather strange concept of true and false. False is represented by NIL, and for convenience there is a variable NIL whose value is NIL. True is represented by anything whose value is not NIL, and for convenience there is a variable T whose value is T (ie, something not NIL).

COND works by going through the conditions until one evaluates to true. The corresponding function-call(s) are then evaluated and the result of the last one to be evaluated is given back as the result of the COND function. Should no condition prove true then COND returns the value NIL. Very often the last condition is the variable T, which is of course always true, and so its function-call(s) will always be evaluated if no other condition is true. This is rather like ELSE in Basic.

Finally, it is useful to be able to define your own functions. In fact, since this is the way you build programs in Lisp, with functions calling functions calling functions and so on, it is essential that there should be a suitably powerful definition facility for functions. The function used for defining functions is called DEFUN. Here is a definition of a function to add two numbers and print out their sum.

```
(DEFUN addpr (a b)
    (PRINTC (PLUS a b)))
```

Notice how I can use lower case variables and functions. It is just that the system functions are defined in upper case. The general form of function definition is:

```
(DEFUN function-name (argument-list)
    (function-evaluation)
    (function-evaluation)
    (function-evaluation)
        .
        .
        .
    (function-evaluation))
```

In the example I gave above addpr is the name of the function. The argument list is (a b) and there is only one function to evaluate. A function always returns as value the result of the last thing it evaluated. In this case the result is the result of (PRINTC (PLUS a b)), which in turn is the value of the last item printed out, ie, (PLUS a b).

We could use our function as follows:

```
(SETQ X (addpr 2 2))
```

which will print out 4 and set the variable X to have the value 4. In fact, function definition is the same as giving a variable a value. A function definition is a special type of list. You will find that addpr now has the value:

```
(LAMBDA (a b) (PRINTC (PLUS a b)))
```

The relationship to the call of DEFUN should be clear. The first argument to the call of DEFUN is the name of the variable which is to be set, and the rest of the arguments appear as a list headed by LAMBDA. LAMBDA is merely a special value, which means the rest of a list is a function definition. Why the name LAMBDA is used will be explained in the last article in this series.

'It is useful to be able to define your own functions'

Lisp functions are recursive, that is, they

can call themselves. Indeed recursive programming is the natural way of programming in Lisp. A recursive function that is in common use is the factorial function. This can be defined mathematically as:

n! = n * (n - 1) * (n - 2) * ... * 2 * 1

and the special case

0! = 1

This works for non-negative whole

'Notice the use of indentation to make the meaning clear'

numbers. Note that n! is read as 'factorial n'. However n! could be defined in terms of the factorial function itself, as follows:

0! = 1
n! = n * (n - 1)!   for n >= 1

So to work out 3! we would first work out 2! and then multiply by 3. To work out 2! we would first work out 1! and then multiply by 2. To work out 1! we would first work out 0! and then multiply by 1. However we are given 0! and so the recursion stops. In Lisp this is:

```
(DEFUN factorial (n)
  (COND
    ((EQ n 0) 1)
    (T (TIMES n (factorial (SUB1 n)))) ))
```

Notice the use of T to provide an ELSE for the COND. SUB1 is a built-in Lisp function that subtracts 1 from its argument. Notice also the use of indentation to make the meaning clear. The Acornsoft Lisp system will in fact force some indentation on you, but you may well wish to add more for clarity. Indentation also helps with counting brackets.

Here is another interesting function.

```
(DEFUN ncall (n)
  (COND
  ((LESSP n 2) 1)
  (T (PLUS 1
     (ncall (SUB1 n))
     (ncall (SUB1 (SUB1 n)))) ))
```

LESSP returns T if its first argument is less than its second. The function ncall returns the number of evaluations of ncall it has done in recursively evaluating ncall (I am grateful to Peter Henderson and William Stoye of Cambridge University for drawing my attention to this function). Armed with a stop watch, you can test how fast Lisp can evaluate functions. Acornsoft Lisp will do about 160 evaluations of ncall per second. For comparison an IBM 3081D running compiled Lisp does more than 300,000 evaluations of ncall per second (and also costs well over a million pounds, so you get about the same cost of hardware per evaluation).

I have yet to explain the use of the editor. for the time being if you get an error just retype the troublesome function – they are all very small.

If something does go wrong Lisp will give an error message, trying to distinguish the fault. For instance:

(CAR 3)

will give error 14 – Attempt to take CAR or CDR of atom. An atom is essentially anything that isn't a list (all will be revealed in the next article). Since CAR and CDR work only on lists, it is not reasonable to give CAR an argument which isn't a list.

Having found an error, Lisp will try to tell you what it was doing at the time – which function argument it was evaluating at the time, and which function call had that argument. If it was evaluating a function that had that function as one of its arguments it will tell you which that function was, and so on until it gets to the function you originally typed in at the "Evaluate:" prompt. For example:

(PLUS 2 (TIMES 1 (CAR 3)))

will give a traceback

```
Error number 14
Arg: 3
Arg: (CAR 3)
Arg: (TIMES 1 (CAR 3))
Arg: (PLUS 2 (TIMES 1 (CAR 3)))
```

This says that trouble occurred when an argument of 3 was found. This was during an evaluation of (CAR 3), which expects a list as argument. This in turn was during the evaluation of (TIMES 1 (CAR 3)), which in turn was during the evaluation of (PLUS 2 (TIMES 1 (CAR 3))), the original expression we typed in.

The example program is fairly simple, but illustrates how Lisp is useful for implementing other languages. In the next two articles I'll show some more of the facilities in Lisp and give some more sophisticated programs. The program is based on an example in *LISP on the BBC Microcomputer*. It is sometimes tedious to have to type in long function names for simple arithmetic operations. It would at least be nice to say:

(+ (* 4 5) 6)

rather than:

(PLUS (TIMES 4 5) 6)

let us define a function to evaluate such expressions. We will only worry about operators with two arguments of the form:

(operator arg_1 arg_2)

To start with we will restrict ourselves to the operators +, −, * and /. Arg_1 and arg_2 can themselves be expressions so we can have expressions of the form:

(operator (operator arg_1 arg_2) (operator arg_3 arg_4))

and so on. Some examples will make this clear:

```
(+ 2 2)
(* (+ 1 2) (+3 4))
(/ (+ 4 6) 5)
```

Clearly we must allow numbers on their own to be expressions. Thus

7

will not surprisingly give the value 7.

Let us now define a function myevaluator to take expressions and return their value. We would like

(myevaluator '(+ 2 2))

to return as value 4.

```
(DEFUN myevaluator (expression)
  (COND
    ((LISTP expression)
      (evaluate-operator)
        (CAR expression)
        (myevaluator (CADR expression))
        (myevaluator (CADDR
                        expression))))
    (T expression)))
```

There are two types of expression to be evaluated: lists of the form

(operator arg_1 arg_2)

and numbers. We use LISTP to test whether an expression is a list. It returns T if its argument is a list. (The P after so many LISP conditionals – we saw LESSP earlier – is mnemonic for Predicate, ie something that is true or false). Having decided that expression is not a number we must now evaluate its two arguments (which may themselves be expressions). We do this by a recursive call to myevaluator, since each argument could itself be an expression. The function CADR is short for

(CAR (CDR . . .))

You should be able to see that applying this to a list will give us the second item in the list (the first argument for the operator), which we then give to myevaluator to evaluate. Similarly CADDR is short for

(CAR (CDR (CDR . . .)))

and picks out the third item in a list. Finally, these are passed with the operator to a

'With a stopwatch you can test how fast Lisp can evaluate functions'

function evaluate-operator which calculates the result for expressions of the form:

(operator number number)

Here is the definition of evaluator-operator:

```
(DEFUN evaluate-operator (op arg1
                              arg2)
  (COND
```

► page 155



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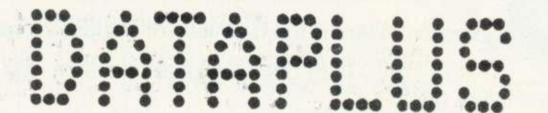
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AC1

ADDING A NEW DIMENSION TO LIFE

Malcolm Banthorpe's Life variations crystallise into cubic creativity

THE MAIN program featured here is a development of the 'life' routines in January's *Acorn User*. The programs in that article made use of Conway's Life algorithm (and variations of it) to generate patterns based upon groups of cells which evolve within a two-dimensional grid in accordance with various sets of rules. The program presented here attempts to expand the 'world' of the cells into three dimensions and hence to generate three-dimensional patterns. It should also demonstrate that 3D computer graphics are not necessarily much more difficult to program than two-dimensional ones. The screen display will be a two-dimensional projection showing the arrangement of the cell patterns in 3D space.

The recent proliferation of computer-generated or computer-inspired graphics in films – particularly in television commercials – has made the public aware of their potential. The most common examples have been 'wire-frame' graphics. This is the simplest form of 3D image and the most generally recognisable as having a computer origin. Wire-frame refers to the typical appearance of such images, in which solid objects are depicted solely by lines (usually glowing green lines when a high-tech image is being promoted) connecting their vertices (corners). As these images show no solid surfaces, only edges, they are effectively transparent and can be confusing, as it is not always obvious which lines are in front of others.

When presented with an image of this type, the human brain may make several interpretations of the information. Rotation or other movement of the image can provide some extra depth clues from the relative movement of the lines and help to decide which is the correct interpretation.

Although wire-frame images are now coming to be regarded as a visual cliché in the media, 3D graphics are still, on the whole, held somewhat in awe in the world of home computing. There is a general suspicion that they are difficult to implement, requiring an extensive knowledge of 3D co-ordinate geometry and a powerful (ie, expensive) computer. In fact, armed with a few general-purpose procedures and a little planning, quite elaborate images can be plotted by anyone with rudimentary programming skills.

Smooth 3D real-time animation of anything but the simplest wire-frame objects is not possible on the BBC micro because the 6502 microprocessor lacks the processing speed necessary to generate the information required to update images at around 25 frames per second. However, it is possible to set up a static scene and then view it from various angles. Programming 3D graphics can become much more complex where general-purpose routines are required for hidden line and surface removal or to take account of lines and surfaces which are wholly or partially behind the viewpoint. However, by restricting the choice of viewpoint, the latter problem can be ignored and the former is solved by making assumptions about what will be visible and employing tricks of programming.



At the simplest level, to draw wire frames, all you need is a new form of plotting command which takes three co-ordinates as its arguments, performs perspective transformation and displays the resulting two-dimensional screen co-ordinates. PROCplot, used in the main program and shown in its simplest form in listing 1, performs this function and takes four arguments. Movement of the viewpoint towards or away from the object is possible but its vertical and lateral positions are fixed. The use of PROCplot is similar to that of the Basic PLOT command, except that it deals with Z co-ordinates as well as X and Y.

The first parameter defines the precise plotting function, so PROCplot(4,X,Y,Z) moves the graphics cursor to absolute location X,Y,Z (or at least to the equivalent X,Y co-ordinate on the screen). The use of '5' as the first parameter draws a line to an absolute three-dimensional location. It is also possible to use '85' to plot the two-dimensional perspective transformation of a solid triangle in three-dimensional space.

All three forms of PROCplot will be used in the main program. As an introduction to its use, listing 1 draws a simple wire-frame cube. The variable VZ% holds the distance of the viewpoint from the theorectical X,Y and Z origin, the viewpoint being at co-ordinates 0,0,VZ%. By varying its value, both image-size and perspective change. Reducing its absolute value and therefore moving closer to the cube will give a larger image and a more pronounced perspective effect – like that of a wide-angle lens. Increasing its value will give a more flattened perspective.

The variable S% is a scaling factor and can be used to vary the image size without changing the perspective. By maintaining a constant ratio of S% to VZ%, you can change the perspective while maintaining approximately the same image size.

The image given by this program is shown in figure 1 – not very impressive and highly ambiguous. Only one facet faces the viewer and without foreknowledge it is unlikely that it would be interpreted as a cube. It can be improved by rotating the cube slightly. For the purpose of the program, this involves rotating the co-ordinates of each of the eight vertices around the origin. Adding the lines in listing 1a rotates the cube around the Y and X axes, by 30 degrees in each direction (figure 2). In a more general-purpose graphics package, separate procedures to perform rotation around the three axes independently would be desirable but, for the purpose of the main program, the simple routine incorporated into PROCplot will suffice.

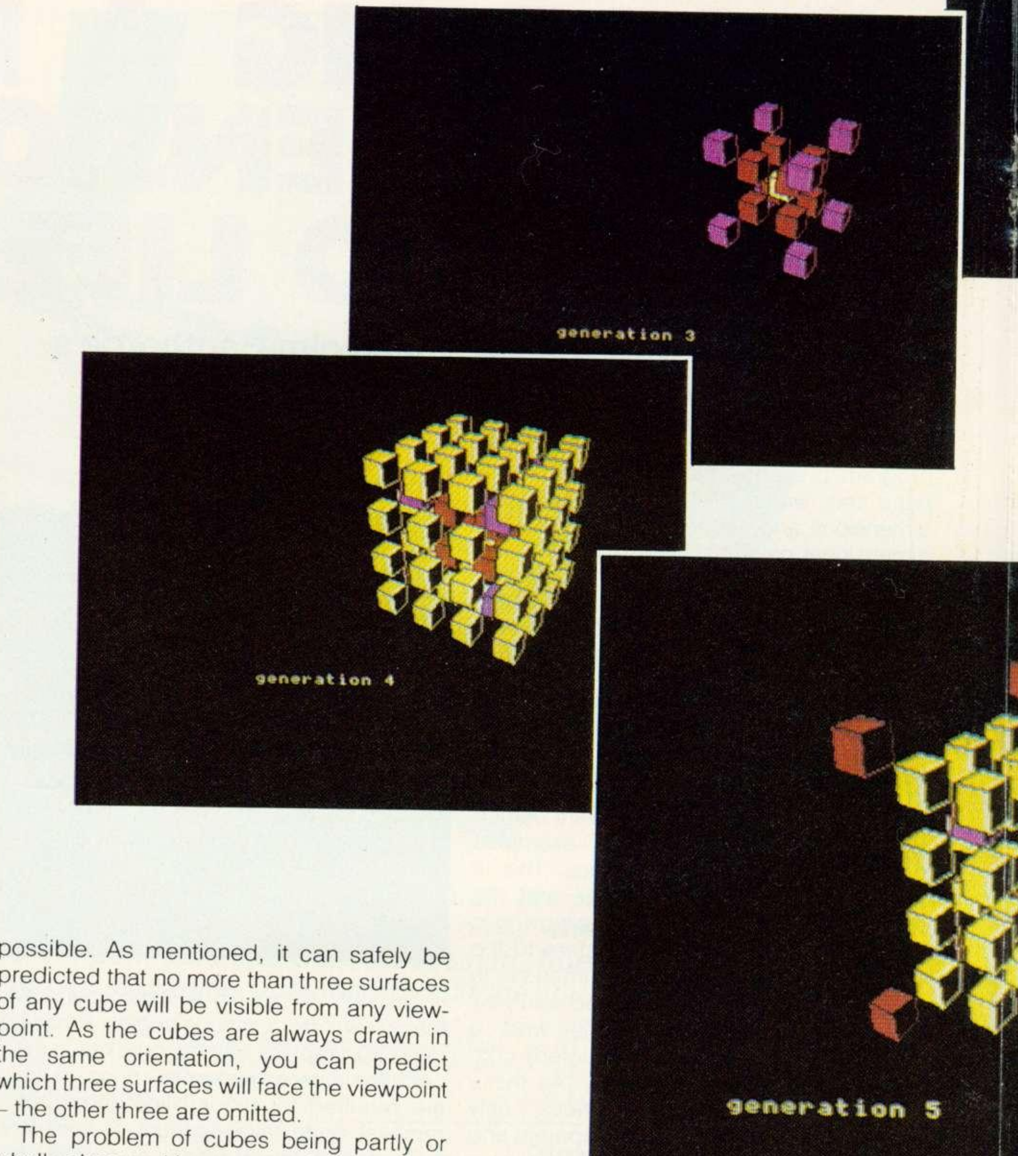
Try changing the angle of rotation in line 40. If the angle of rotation is fixed, or at least restricted to a narrow range, it becomes possible to predict which edges of the cube would be visible if the cube were solid. So one way of dealing with the 'hidden' edges is simply to plot the cube as if they didn't exist. If the program is now run with the angle at 30 degees, and further modified so that line 140 becomes:

```
140 DATA 11
```

and lines 260 to 300 are deleted, the result is the more solid-looking cube of figure 3.

Proceeding to the main program (listing 2), the world in which the cells exist will be a 15 × 15 × 15 cubic grid or matrix giving 3,375 possible locations. The future state of any empty location will be determined by the states of some or all of the 26 locations which immediately border it.

It is more difficult to visualise a 3D grid



than a two-dimensional one. Figures 4 and 5 should help clarify the situation. Figure 4 shows the 15 × 15 × 15 matrix drawn in a perspective similar to that used in the program. The whole matrix is a cube, each location consisting of a smaller cube. Each of the 3,375 smaller cubes is a potential cell location and this is the sort of display obtained if each location is occupied. When the program is run, cubes will be drawn only at locations containing cells.

Figure 5 is a closer view of a 3 × 3 × 3 section of the matrix. The darker cube at the centre, marked with an X, represents a target location, surrounded by the 26 neighbours which will determine its future state. Adjacent cubes are shown with space between them to make the structure clearer; in the program, adjacent cells will be drawn in contact, as in figure 4.

Rules to determine the creation and continuing existence of cells will be based on the variations given in my previous article. These have been chosen to provide sequences of patterns which, when applied to most initial cell groups, will generally (though not always) steadily increase in overall size from generation to generation. As shown in the main program listing, they are:

1. Each cell survives for exactly three generations and then vanishes.
2. Only those eight bordering locations shown in figure 6 are taken into account.
3. Any empty location with only one neighbour gives birth to a new cell.

For the purpose of rule 3, only first- and second-generation cells are included in the count. By not including third-generation cells, which are about to vanish in the next generation, the amount of array space required by the program is halved, permitting a larger maximum grid size.

Mode 1 is used to display the results so that a different logical colour can be assigned to each new generation. Three colours represent first, second and third-generation cells, while black indicates an empty location. The colour of an individual cell does not change as it progresses from first to third generation but at any time the three generations will be of different colours. Once a cell is created it remains the same colour throughout the three stages of its life.

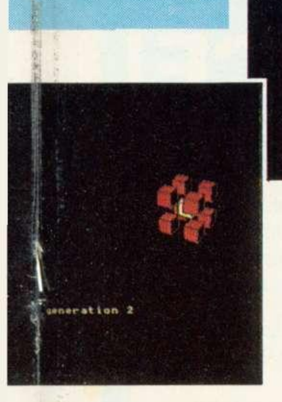
Sequence 1 (this page) shows the first six generations that result from the application of these rules to a single cell. Cubes were chosen to represent the cells as they conveniently fit into the grid structure and are simple to represent in two dimensions. Two elementary forms of hidden surface removal have been employed to improve on the wire-frame cubes shown earlier and to make the display as unambiguous as possible. As mentioned, it can safely be predicted that no more than three surfaces of any cube will be visible from any viewpoint. As the cubes are always drawn in the same orientation, you can predict which three surfaces will face the viewpoint – the other three are omitted.

The problem of cubes being partly or wholly obscured by nearer cubes is solved by plotting each generation from the furthest cube, the next furthest and so on. As each facet is plotted as a solid block of colour, it erases anything already plotted in the same screen position. Displaying the contents of the entire matrix in practice involves scanning the 15 × 15 × 15 grid from the bottom left-hand location of the furthest 15 × 15 'slice' (which forms the rear, hidden, surface in figure 4) and then proceeding slice by slice to the front surface. If an occupied location is found a cube is drawn at the appropriate co-ordinates. This may be difficult to visualise but observation of the program in action, building up the display cube by cube, should clarify what is happening.

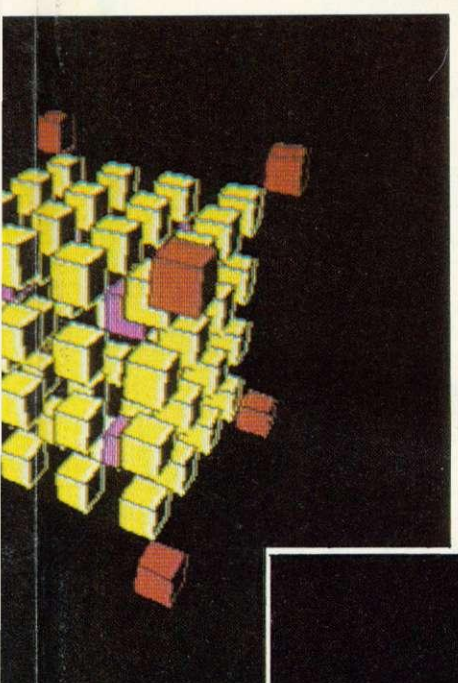
A 15 × 15 × 15 grid was chosen as the largest that can conveniently be accommodated within the program and still leave enough memory for the use of mode 1. This grid size generally allows up to six generations to be processed before the results become invalid because the cell group is approaching the limits of the matrix. A normal integer array of this size, using four bytes per element, would take up more memory than is available and would in any case waste memory, considering the limited range of values to be stored. One byte per element is more than adequate for this purpose and, although still somewhat wasteful, a single-byte array is easily set up and manipulated to be addressable as a three-dimensional array.

Line 60 reserves 3,375 bytes, starting at the address held in the variable Array%. Line 70 sets each element to zero since, unlike conventional arrays, this does not automatically occur when the array is dimensioned. PROCwrite takes four arguments: the three array dimensions and the value to be stored. FNread takes three array dimensions as its arguments and returns the stored value.

For those wishing to experiment with larger grids there are two possibilities: first, use of mode 5 allows a four-colour display to be retained, at lower resolution, and releases another 10k of memory for array



SEQUENCE 1



space; second, as only two bits per array element are required to store the values 0,1,2 and 3, more complex definitions of FNread and PROCwrite could be written to permit more compact storage of the data, with four elements compressed into each byte.

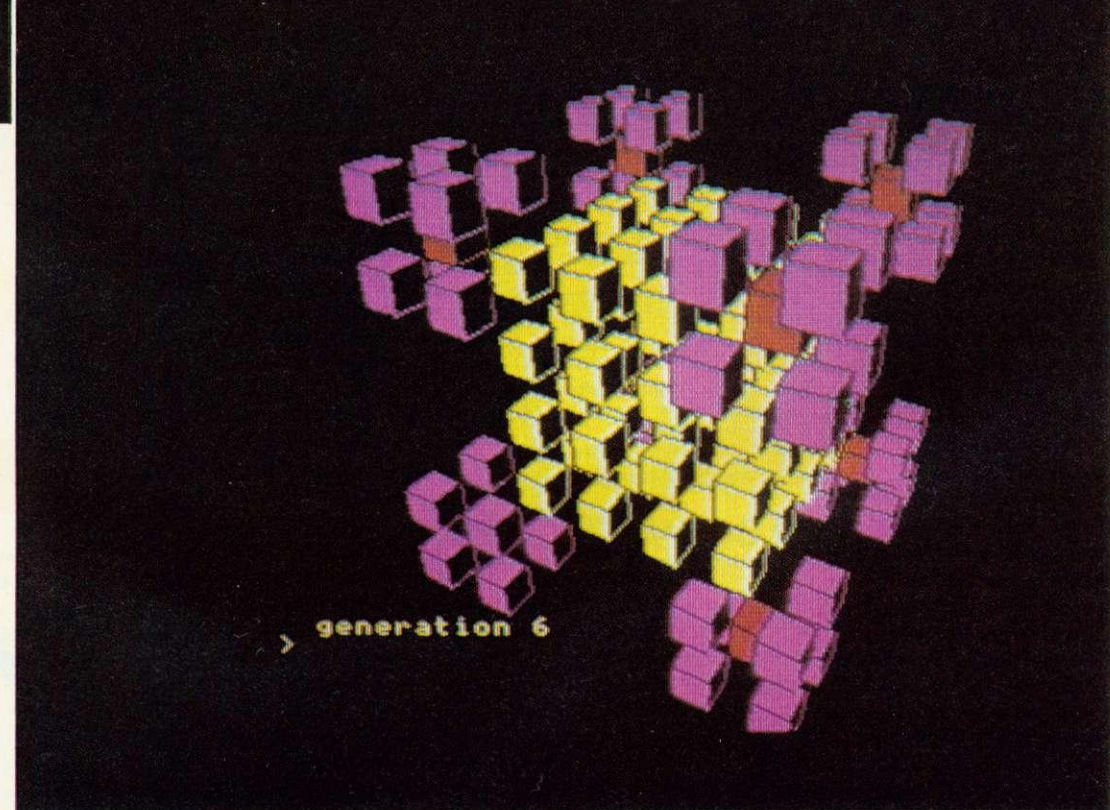
The following descriptions of the other procedures should help if you wish to make modifications to the program.

PROCdesign allows an initial cell pattern to be set up. The single value in the first line of data is the number of cells to be set up. The following line of data contains the X,Y and Z co-ordinates of each cell. The centre of the grid is location 7,7,7 and the initial pattern would normally be centred around this point.

PROCshow displays the current cell generation. It operates by scanning the grid in the manner described, starting with the location furthest from the viewpoint. To save time, it is possible to scan the part of the grid in which cells are known to exist – this has been implemented within the procedure as listed. G% is a variable containing the number of the current generation. If the overall size of the initial cell pattern doesn't exceed 3 × 3 × 3 and is centred at location 7,7,7 then, with the above rules, the overall size of the group will not increase by more than one location in any direction from one generation to the next. The procedure as shown assumes these conditions and, on findng an occupied location, calls PROCcube. If a larger initial cell group is required or if it is to be positioned off-centre, then PROCshow should be modified. If in doubt, scan the full extent of the grid (0 to 14) in all three directions.

PROCcube takes four arguments. The first three are the co-ordinates of the bottom left front corner of the cube and thus determine its position. The fourth is the logical colour in which it will be displayed. The procedure calls PROCfront, PROCtop and PROCside, which supply the data for the drawing of the parts of the cube suggested by their names. Each procedure in turn calls PROCfacet, which draws a solid facet by using 85 as the first argument of PROCplot (to obscure any previously plotted surfaces which should be hidden). An outline of the facet is also drawn.

PROCplot was described earlier. The angle of rotation can be varied to a limited extent to obtain different views, but too



much variation will foul the simple method of hidden surface removal. Surfaces and edges assumed not to be visible and therefore not plotted may now theoretically come into sight. Conversely, some surfaces and edges will be drawn which should not actually be visible.

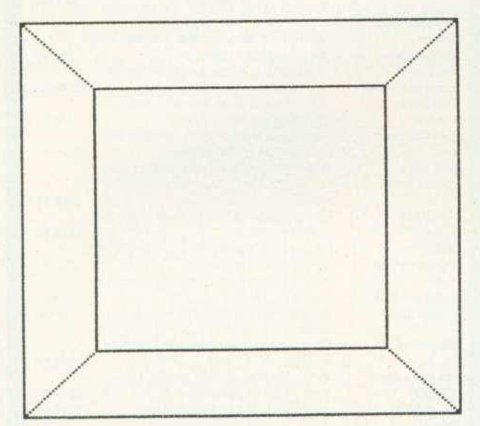


Figure 1. Simple '3D' cube form of the kind produced by listing 1

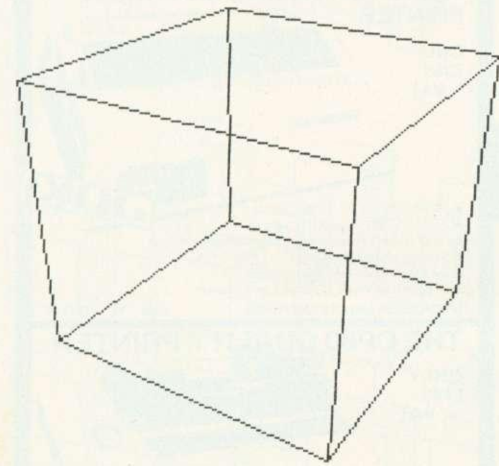


Figure 2. Rotation of the cube

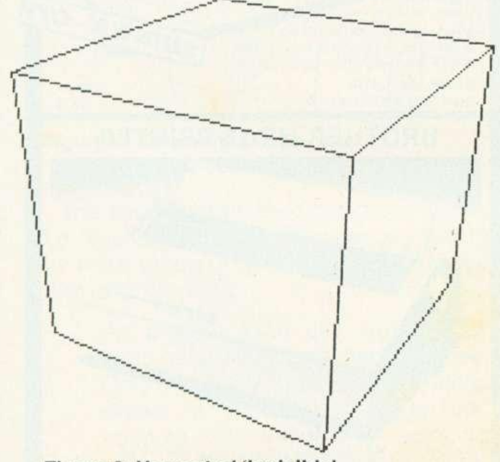


Figure 3. Unwanted 'invisible' lines not plotted

PROCmain is the procedure which examines the current state of the grid and determines the next generation. As in PROCshow, some time is saved in the earlier generations by scanning only the part of the grid known to contain cells. The same comments apply, but where the full

Listing 1. Simple wire-frame cube

```
 10 MODE4
 20 VDU29,640;512;
 30 VZ%=-500:S%=1200
 70 READ N%
 80 FOR I%=1 TO N%
 90 READ K%,X%,Y%,Z%
100 PROCplot(K%,X%,Y%,Z%)
110 NEXT
120 END
130
140 DATA 16
150 DATA 4,100,-100,-100
160 DATA 5,100,100,-100
170 DATA 5,-100,100,-100
180 DATA 5,-100,-100,-100
190 DATA 5,100,-100,-100
200 DATA 5,100,-100,100
210 DATA 5,100,100,100
220 DATA 5,100,100,-100
230 DATA 4,100,100,100
240 DATA 5,-100,100,100
250 DATA 5,-100,100,-100
260 DATA 4,-100,-100,-100
270 DATA 5,-100,-100,100
280 DATA 5,-100,100,100
290 DATA 4,-100,-100,100
300 DATA 5,100,-100,100
310
320 DEFPROCplot(K%,X%,Y%,Z%)
350 M=S%/(Z%-VZ%):PLOTK%,X%*M,Y%*M
360 ENDPROC
```

Listing 1a. Thirty degree rotation

```
 40 Angle=30
 50 Sin=SINRAD(-Angle)
 60 Cos=COSRAD(-Angle)
320 DEFPROCplot(K%,X%,Y%,Z%)
330 x%=X%*Cos-Z%*Sin:z%=Z%*Cos+X%*Sin
340 y%=Y%*Cos-z%*Sin:z%=z%*Cos+Y%*Sin
350 M=S%/(z%-VZ%):PLOTK%,x%*M,y%*M
360 ENDPROC
```

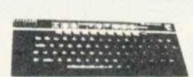
Listing 2. It's a cubic world

```
 10 MODE1:VDU29,640;400;
 20 VDU23;8202;0;0;0;
 30 Angle=30
 40 Sin=SINRAD-Angle:Cos=COSRAD-Angle
 50 VDU19,1,1;0;19,2,5;0;19,3,3;0;
 60 DIMArray%3375:VZ%=-2000:S%=1600
 70 FORI%=0TO3375:I%?Array%=0:NEXT
 80 PROCdesign
 90 G%=1:colour=3
100 PROCshow
110 PROCmain:END
120 :
130 DEFPROCmain
140 C=2
150 REPEAT
160 G%=G%+1
170 C=C+1:colour=C MOD3+1
180 FORX%=7-G%TO7+G%
```

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BBC Microcomputer System

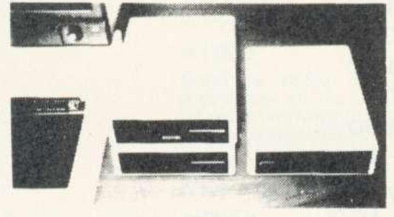
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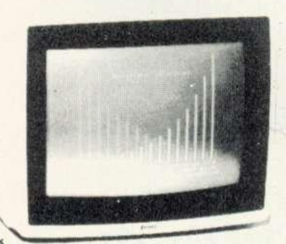
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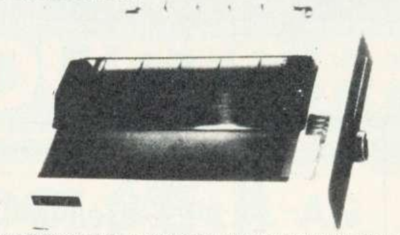
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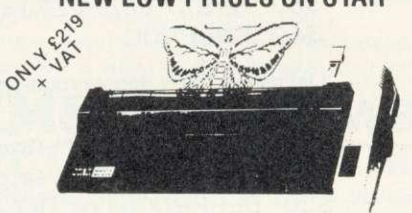
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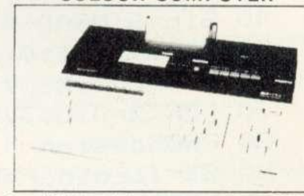


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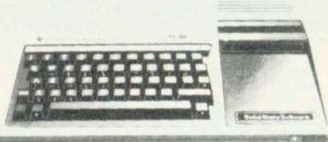


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extent of the grid is to be scanned the range should be 1 to 13 in each direction (in lines 180 to 200) to prevent the program examining locations outside the grid. This procedure also determines which neighbouring locations are to be taken into account and the rules to be applied. Details for varying both are given below. The future states of all locations are determined before the screen is cleared and the next generation displayed.

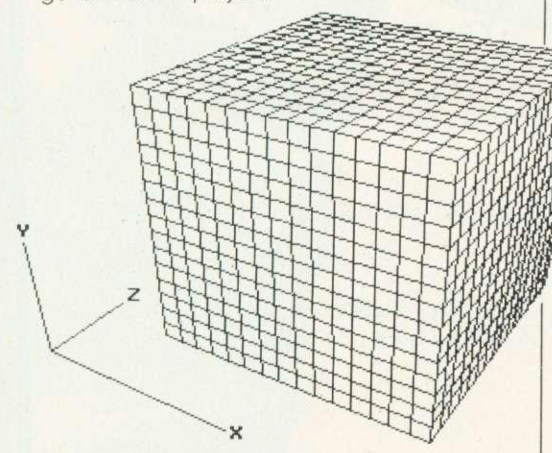


Figure 4. Cubes in a cubic matrix

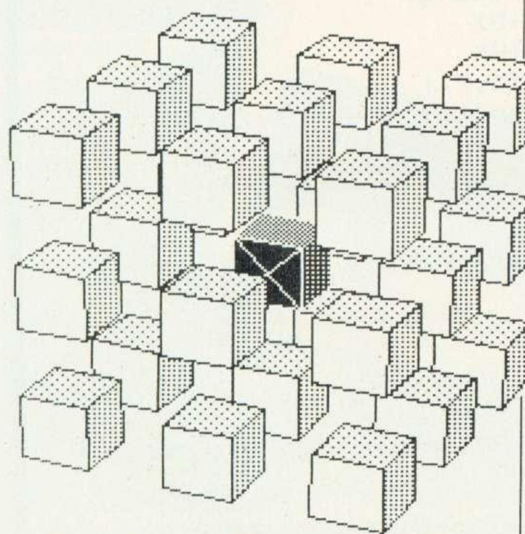


Figure 5. Close-up of a section of the cubic matrix

The sequence on the front cover shows the result of the following rules applied to the initial group of six cells arranged in the form of a 3D cross:

1. As before, each cell survives for three generations and then vanishes.
2. Only those six bordering locations shown in figure 7 are taken into account. As in figure 5, adjacent cells are shown separated for clarity.
3. Any empty location with an odd number of neighbours gives birth to a new cell.

These rules are implemented by deleting lines 220 to 280, 310, 1090 and 1100 of the main program and adding the lines shown in listing 2a.

It has probably become obvious by now, in looking at the resulting displays, that

► from page 95

```
190 FORY%=7-G%TO7+G%
200 FORZ%=7-G%TO7+G%
210 count%=0
220 FORy%=Y%-1TOY%+1STEP2
230 FORx%=X%-1TOX%+1STEP2
240 FORz%=Z%-1TOZ%+1STEP2
250 PROCcount(x%,y%,z%)
260 NEXT
270 NEXT
280 NEXT
290 thiscell%=FNread(X%,Y%,Z%)
300 IFthiscell%=colour PROCwrite(X%,Y%,Z%,0)
310 IFthiscell%=0 THEN IF count%=1 PROCwrite
(X%,Y%,Z%,colour)
320 NEXT
330 NEXT
340 NEXT
350 PROCshow
360 UNTILG%=7
370 ENDPROC
380 :
390 DEFPROCcount(X%,Y%,Z%)
400 T%=FNread(X%,Y%,Z%)
410 IF T%>0 THEN IF T%<>colour count%=count%+1
420 ENDPROC
430 :
440 DEFPROCplot(K%,X%,Y%,Z%) LOCALx%,y%,z%
450 x%=X%*Cos-Z%*Sin:z%=Z%*Cos+X%*Sin
460 y%=Y%*Cos-z%*Sin:z%=z%*Cos+Y%*Sin
470 M=S%/(z%-VZ%):PLOTK%,x%*M,y%*M
480 ENDPROC
490 :
500 DEFPROCside(X%,Y%,Z%)
510 RESTORE520:PROCfacet(0)
520 DATA4,0,0,0, 4,0,0,100, 85,0,100,0, 85,
0,100,100
530 DATA5,0,100,0, 5,0,0,0, 5,0,0,100, 5,0,
100,100
540 ENDPROC
550 :
560 DEFPROCfront(X%,Y%,Z%)
570 RESTORE580:PROCfacet(C)
580 DATA4,0,0,0, 4,100,0,0, 85,0,100,0,
85,100,100,0
590 DATA5,0,100,0, 5,0,0,0, 5,100,0,0,
5,100,100,0
600 ENDPROC
610 :
620 DEFPROCtop(X%,Y%,Z%)
630 RESTORE640:PROCfacet(C)
640 DATA4,0,0,0, 4,0,0,100, 85,100,0,0,
85,100,0,100
650 DATA5,100,0,0, 5,0,0,0, 5,0,0,100,
5,100,0,100
660 ENDPROC
670 :
680 DEFPROCfacet(N)
690 GCOL0,N
700 FORI%=1TO4:READK%,A%,B%,C%
```

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much of the inner structure of the cell groups is hidden by the outer cells (although it can be seen transiently while the display is being plotted). One way of remedying this without losing any real information (as long as the cell structure is symmetrical along the Z axis) is to display only the rear half of the grid so that any cells around location 7,7,7 are always visible in the final displays. This is

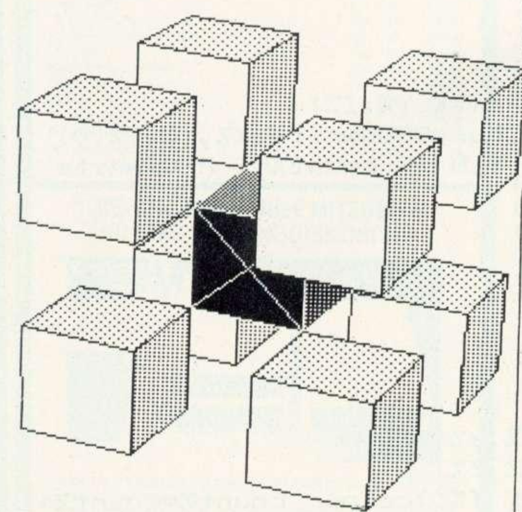


Figure 6. Target location and eight bordering locations (see sequence 1)

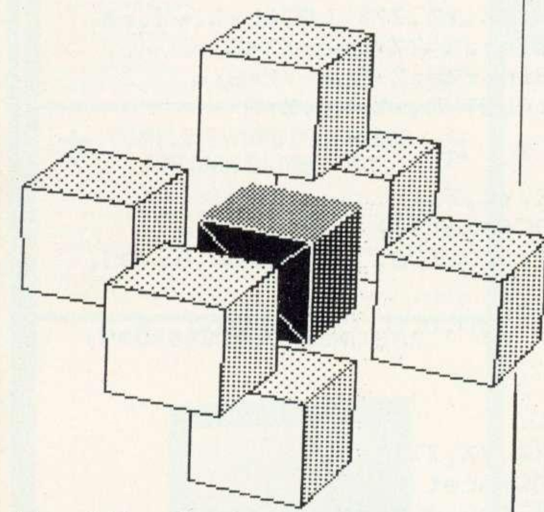


Figure 7. Target location and six bordering locations (see cover sequence)

achieved by changing line 930 of PROCshow to:

930 FOR Z%=7+G% TO 7 STEP−1

With PAGE set to &1900, as is normal on a disc-based machine, there is just enough memory to run the program, provided no extraneous spaces are included. If you find that the program grinds to a halt with a 'no room' message, first make sure that you have saved a copy of the program, then set PAGE to &1200 and reload it. Most disc filing systems will still allow SAVE, LOAD and CHAIN operations at this PAGE setting. Alternatively, modify the first line of the program so that it runs in mode 5.

Finally, and as further food for thought,

► from page 97

```
 710 PROCplot(K%,X%+A%,Y%+B%,Z%+C%)
 720 NEXT
 730  GCOL0,C EOR N
 740 FORI%=1TO4:READK%,A%,B%,C%
 750 PROCplot(K%,X%+A%,Y%+B%,Z%+C%)
 760 NEXT
 770 ENDPROC
 780 :
 790 DEFPROCcube(X%,Y%,Z%,C)
 800 PROCfront(X%,Y%,Z%)
 810 PROCside(X%+100,Y%,Z%)
 820 PROCtop(X%,Y%+100,Z%)
 830 ENDPROC
 840 :
 850 DEFFNread(X%,Y%,Z%)=Array%?
(X%+(Y%+Z%*15)*15)
 860 :
 870 DEFPROCwrite(X%,Y%,Z%,N%)
 880 Array%?(X%+(Y%+Z%*15)*15)=N%
 890 ENDPROC
 900 :
 910 DEFPROCshow
 920 CLS
 930 FORZ%=7+G%TO7-G%STEP-1
 940 FORY%=7-G%TO7+G%
 950 FORX%=7-G%TO7+G%
 960 T%=FNread(X%,Y%,Z%)
 970 IFT%<>0PROCcube(X%*100-700,Y%*100-700,
Z%*100-700,T%)
 980 NEXT
 990 NEXT
1000 NEXT
1010 PRINTTAB(2,28)"generation ";G%
1020 ENDPROC
1030 :
1040 DEFPROCdesign
1050 RESTORE1090
1060 READN%:FORI%=1TON%
1070 READX%,Y%,Z%:PROCwrite(X%,Y%,Z%,3)
1080 NEXT
1090 DATA 1
1100 DATA 7,7,7
1110 ENDPROC
```

Listing 2a.

```
 220FORy%=Y%-1TOY%+1STEP2
 225PROCcount(X%,y%,Z%)
 230NEXT
 235FORx%=X%-1TOX%+1STEP2
 240PROCcount(x%,Y%,Z%)
 245NEXT
 250FORz%=Z%-1TOZ%+1STEP2
 255PROCcount(X%,Y%,z%)
 260NEXT
 310IFthiscell%=0 THEN IF count%MOD2=1
PROCwrite(X%,Y%,Z%,colour)
 1090DATA 6
 1100DATA 7,7,6, 7,7,8, 7,6,7, 7,8,7, 6,7,7,
8,7,7
```

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Note: If dealer, please attach this form to your letterheading

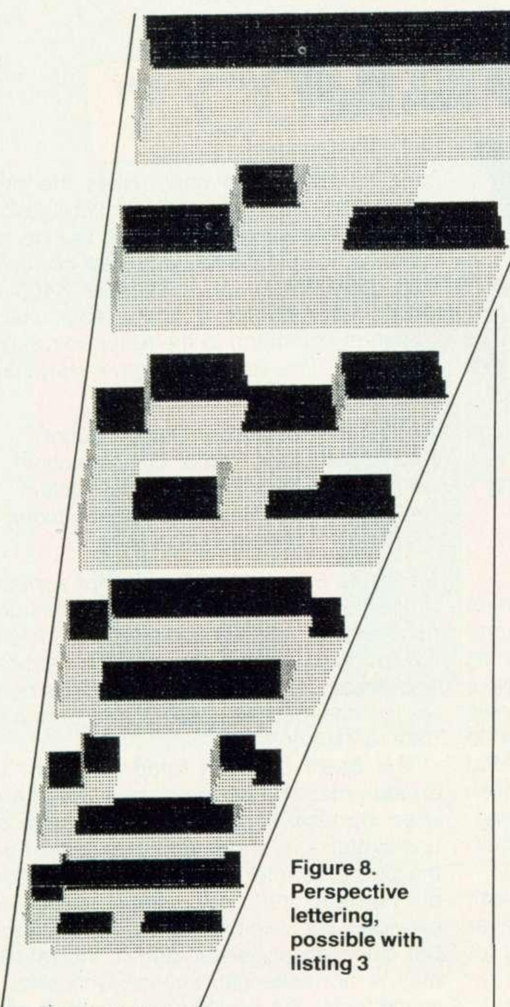


Figure 8. Perspective lettering, possible with listing 3

listing 3 shows how the same sort of cube drawing routine can be used as a building block for more complex 3D displays. This program allows the creation of solid-looking lettering, drawn in perspective (figure 8). The variable W$, defined in line 70, contains the string to be printed.

Taking each letter in turn, the program looks up the appropriate character definition in the operating system ROM and uses the stored pixel patterns to decide where the cubes should be placed. The cubes are in effect being used as three-dimensional pixels. Slightly different definitions of PROCcube and the procedures called by it are used because each of the three visible facets is a different colour and a separate outline of each facet is not required.

The cubes are rotated only about the Y axis this time so that vertical lines in the lettering will remain vertical. As before, hidden surface removal is achieved by starting the plotting at the furthest point from the viewpoint – in this case the leftmost, lowest pixel of the first letter – and proceeding forward along the string. To accommodate longer strings than the one shown the scaling factor and viewing distance must be varied. Other orientations of the display are possible by varying the angle of rotation, but some will require a different selection of cube facets to be drawn, as explained earlier, to achieve the correct hidden surface effect. ●

► *from page 98*

Listing 3.

```
 10 MODE1:VDU29,440;900;
 20 Angle=60
 30 VDU23;8202;0;0;0;
 40 Sin=SINRAD(-Angle):Cos=COSRAD(-Angle)
 50 VDU19,1,6;0;19,2,2;0;19,3,4;0;
 60 VZ%=-4000:S%=2000
 70 W$="ACORN"
 80 FOR H%=1 TO LENW$
 90 L%=&BF00+8*ASCMID$(W$,H%,1)
100 FORI%=7 TO 0 STEP-1
110 FORJ%=7 TO 0 STEP-1
120 IF (L%?I% AND 2^J%) THEN PROCcube(-2400+800*
H%-J%*100,-500-I%*100,0)
130 NEXT
140 NEXT
150 NEXT
160 END
170 :
180  DEFPROCplot(K%,X%,Y%,Z%)
190 x%=X%*Cos-Z%*Sin:z%=Z%*Cos+X%*Sin
200 y%=Y%
210 M=S%/(z%-VZ%):PLOTK%,x%*M,y%*M
220 ENDPROC
230 :
240 DEFPROCside(X%,Y%,Z%)
250 RESTORE260:PROCfacet(3)
260 DATA4,0,0,0, 4,0,0,100, 85,0,100,0,
85,0,100,100
270 ENDPROC
280 :
290 DEFPROCfront(X%,Y%,Z%)
300 RESTORE310:PROCfacet(1)
310 DATA4,0,0,0, 4,100,0,0, 85,0,100,0,
85,100,100,0
320 ENDPROC
330 :
340 DEFPROCtop(X%,Y%,Z%)
350 RESTORE360:PROCfacet(2)
360 DATA4.0.0.0. 4.0.0.100. 85.100.0.0.
85.100.0.100
370 ENDPROC
380 :
390 DEFPROCfacet(N) LOCAL I%
400 GCOL0,N
410 FORI%=1TO4:READK%,A%,B%,C%
420 PROCplot(K%,X%+A%,Y%+B%,Z%+C%)
430 NEXT
440 ENDPROC
450 :
460 DEFPROCcube(X%,Y%,Z%)
470 PROCfront(X%,Y%,Z%)
480 PROCside(X%+100,Y%,Z%)
490 PROCtop(X%,Y%+100,Z%)
500 ENDPROC
```

EXTENDED VIEW

Tony Rudkin creates a driver routine which supports a wide range of printer functions and provides the pad character missing from the View facility

VARIOUS comparisons have been made between the relative merits of Acornsoft's View and Computer Concepts' Wordwise (for example, Paul Beverley's detailed review in the June issue of *Acorn User*). Having had access to both word processing packages, I admit to a personal preference for View, mainly because I can see the formatted text as it is created, regardless of the mode. Having to save a text file before being able to print it is time-consuming with tapes, although it does encourage good housekeeping. With discs, of course, the time penalty is much reduced.

View differs considerably from Wordwise in the way the information is sent to the printer and a 'printer driver' is needed to gain access to the various printer facilities, such as underline, emboldening and superscript. Without this driver routine View simply sends the text to the printer via a default routine that does not support any of the facilities. Printer commands are inserted into the text as highlight codes with ASCII values from 128 upwards, and the printer driver has to recognise these codes and send the necessary commands to the printer.

Acornsoft can supply a tape with a collection of six driver routines for different printers for just under £10, but the company also includes some brief information in the *Into View* booklet (page 74) to enable the enthusiast to create his or her own driver. Since I have only one printer to consider (an Epson MX-80F/T III) I decided to write my own routine, which in addition to supporting a wide range of printer functions will also provide the vital 'pad' character facility that is missing from View.

The two-page section in the Acornsoft manual which deals with printer driver formatting provides general guidelines for creating the driver and makes the programming appear relatively straightforward. The assembly language routine resides at location &400 and can be up to 256 bytes long, with addresses &400 to &40E reserved for a jump table which transfers command to the required area of the driver. The addresses and instructions are:

&400 JMP Character Output routine
&403 JMP Turn Printer On instruction
&406 JMP Turn Printer Off instruction
&409 JMP Set Horizontal Motion Index
&40C JMP Return Option Byte

Since the Epson MX-80 does not support proportional spacing the last two instructions are not needed and simply point to a return command in the assembly code. The remaining jump instructions pass control to three routines which control output of data to the printer.

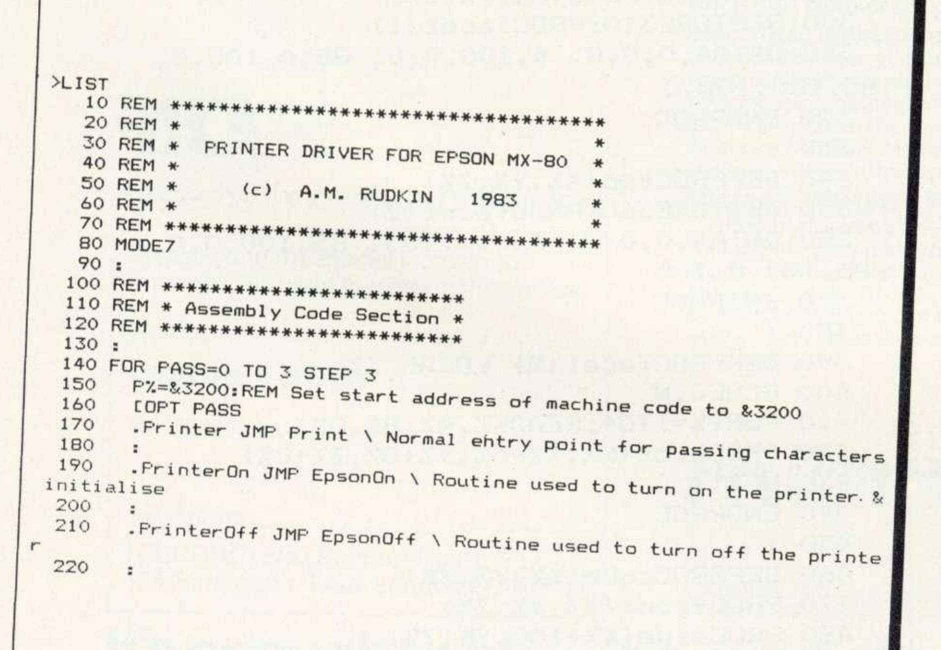
The Basic program listed (program 1) creates machine code routines which are used by View to implement a number of useful highlight codes and also to provide the pad character facility. The description of the machine code which follows is provided for experienced programmers, but since an understanding of the principles is not essential, anyone who simply wants to use the facilities of the routine can omit this section and move on to the description of the Basic program.

The Printer On routine is called by the jump instruction at address &403, and the first time it is called the printer output is enabled and a general printer initialisation is done by sending the equivalent of ESC @. This clears any existing printer conditions that may have been set up by a prevous printing session (eg, a Basic program). The paper-end detector is then disabled so that single-sheet printing is possible. A flag is then set at address &4FF which prevents the printer from being re-initialised next time it is turned on by View. This is necessary because in the single-sheet printing mode View turns the printer off at the end of a sheet and back on again at the start of the next sheet.

Re-initialising the printer would clear any highlight commands that had been set to apply to the whole document (for example the use of the condensed character set to obtain 132 characters per line).

The Printer Off routine is called by the jump instruction at address &406 and simply disables the printer output by sending a command equivalent to CTRL C (or VDU 3) in Basic. No flags are affected and existing highlight commands are preserved.

The major routine is devoted to handling the output of characters to the printer and detecting any highlight instructions. Char-



Program 1. Printer driver in machine code, with check routine in Basic

```
>LIST
   10 REM *************************************
   20 REM *                                   *
   30 REM *  PRINTER DRIVER FOR EPSON MX-80   *
   40 REM *                                   *
   50 REM *     (c)  A.M. RUDKIN   1983       *
   60 REM *                                   *
   70 REM *************************************
   80 MODE7
   90 :
  100 REM *************************
  110 REM * Assembly Code Section *
  120 REM *************************
  130 :
  140 FOR PASS=0 TO 3 STEP 3
  150   P%=&3200:REM Set start address of machine code to &3200
  160   [OPT PASS
  170   .Printer JMP Print \ Normal ehtry point for passing characters
  180   :
  190   .PrinterOn JMP EpsonOn \ Routine used to turn on the printer &
 initialise
  200   :
  210   .PrinterOff JMP EpsonOff \ Routine used to turn off the printe
r
  220   :
```

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acters are transferred from View as ASCII values in the range 32 to 126 and these can be passed directly to the printer for normal printing, but to provide a pad character (ie, one which prints a space on the printer but is handled by View as a real character) the unused '£' character on the same key as the underline symbol is detected and replaced by a space.

Pad characters are very useful in preventing extra spaces from being inserted during formatting or words from being split at the end of a line. Unlike Wordwise, View does not provide a pad character facility and putting one into the printer driver routine adds a useful feature to this powerful word processing package.

Any ASCII value higher than 127 represents a highlight command, and these are passed to the section of the program that determines the action to be taken and sends the required command to the printer.

Highlight codes supported by the printer driver are:

128	Underline
129	Emphasised characters
130	Double-height characters
131	Condensed characters
132	Superscript
133	Subscript

Each command has a 'toggle' action – the first time the command is received the facility is turned on, and the second time it is turned off. For this reason flags are allocated within the program and an important section of the printer driver checks the status of these flags to determine the action required.

The underline facility is controlled by code 128. Having detected this code the underline flag is checked; if it is not set underlining is switched on by sending the command ESC 45,1 to the printer. The flag is set and the routine exits. The next time the 128 code is received the command ESC 45,0 is sent to the printer to switch off the underline and the flag is reset.

Receipt of code 129 causes the emphasised flag to be checked. If it is not set the emphasised command, ESC 69, is sent to the printer and the flag is set. On receipt of the next 129 code the ESC 70 command is sent to the printer and the flag reset.

Code 130 controls the wide character facility and when first received causes the command ESC 87,1 to be sent to the printer and the double-width flag to be set. On receipt of the next 130 code the flag is reset and the command ESC 87,0 passed to the printer. The double-width mode gives a line length of 40 characters when applied to the normal character set. ESC 87 is used in preference to the SI and DC4 commands as it allows double-width condensed characters (66 characters per line).

Condensed characters are selected by code 131, which when first applied causes the command SI (15) to be sent to the printer and then sets the condensed character flag on. Next time the 131 code is received the command DC2 (18) is sent to the printer to disable the condensed character mode and the flag is reset. The condensed mode gives a line length of 132 characters.

KEY	FUNCTION
A	Underlined text
B	Emphasised text
C	Double-width characters
D	Condensed characters
E	Superscript characters
F	Subscript characters
G	Underline & Emphasised
H	Underline & Double-width
I	Underline & Condensed
J	Underline & Superscript
K	Underline & Subscript
L	Emphasised & Double-width
M	Double-width & Condensed
N	Condensed & Superscript
O	Condensed & Subscript
Z	Modify and save the printer driver

Figure 1. Key functions used in testing the machine code routines

When the superscript command (code 132) is first sent, it causes the command ESC 53,0 to be sent to the printer to select the superscript mode and also sets the superscript flag. The next time this code is received the superscript mode is terminated by resetting the flag and sending ESC 84, followed by ESC 72, to the printer. The latter code cancels the double printing mode, which is automatically selected by the Epson printer when the superscript facility is requested. The subscript mode (code 133) works in exactly the same way as the superscript mode but sends the printer command ESC 53,1 to select the subscript facility.

The area used by View for its printer drivers (&400 to &4FF) is normally used by the Basic language ROM, and attempting to write directly to this area from a Basic program will cause problems. The first section of the program therefore creates a printer driver package in the &3200 to &32FF region, which a later section modifies so that it can be stored on tape (or disc) for loading to the &400 address in View. This two-stage approach has the advantage that de-bugging can take place without the need to leave Basic and enter the View facility.

Keys are assigned within the first program for test purposes and check the printer driver by sending commands and text to the printer. The key functions are shown in figure 1.

In creating the machine code routine the program assumes that the auto line-feed switch inside the Epson printer has been set to the 'on' position as described on page 46 of the handbook. In this position the printer will automatically insert a line-feed instruction whenever a carriage-return character is received. Failure to select this switch will result in all the text being

◄ from page 102

```
  230   .HMI JMP Return \ Horizontal Motion Index not supported, so re
turn
  240   :
  250   .Option JMP Return \ Sets option bytes - not needed for Epson
  260   :
  270   .EpsonOn LDA#2:JSR&FFEE \ Allows output to printer
  280   LDA&32FF:BNE Return \ Has printer been selected before ?
  290   LDA#64:JSR Escape \   If not then initialise printer
  300   LDA#56:JSR Escape \   and switch off paper end detector.
  310   INC&32FF \ Set printer bit on
  320   .Return RTS \ Return from Setting Epson On
  330   :
  340   .EpsonOff LDA#3:JSR&FFEE:RTS \ Disable printer and return
  350   :
  360   .Print STA&32F0:STX&32F1:STY&32F2 \ Store contents of Register
s
  370   BMI Highlight \ Branch to 'Highlight' if Character value >=128
  380   CMP#96:BNE CharOut:LDA#32:STA&32F0 \ Allows Pound symbol to be
 used as a pad character
  390   :
  400   .CharOut JSR &FFE3 \ Print character to screen & printer
  410   :
  420   .Highlight CMP#128:BEQ Underline \ Code 128 = Underline on/off
  430   CMP#129:BEQ Emphasized \ Code 129 = Emphasized Characters on/o
ff
  440   CMP#130:BEQ DoubleWidth \ Code 130 = Double Width characters
```

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ROMS SOFTWARE FOR THE BBC MICRO



DISC DOCTOR

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Because the above programs are in ROM they are always available, and usually take no user memory when operating. All the commands can be used from within BASIC programs and the ROMs includes a help menu listing the syntax of all commands.

```
WORDWISE
(C) Computer Concepts 1982

1) Save entire text
2) Load new text
3) Save marked text
4) Load text to cursor
5) Search and Replace
6) Print text
7) Preview text
8) Spool text

ESC Edit Mode

Please enter choice_
```

WORDWISE

This ROM based word processor is simple to fit and simple to operate. Its greatest strength lies in its ease of use, yet it is a fully fledged text processing system, with all the features you would expect to find in many more expensive programs.

Once entered the user has total control over the text. Any section may be marked, this may be a word, sentence or any larger piece of text. The marked section may then be instantly deleted, moved or copied to any other point in the document. The more complex operations are menu driven so that the user is always prompted when necessary. When printing a document the user may specify the line length, line spacing, page length etc. WORDWISE even handles automatic page numbering, centering of text, justification and many more powerful features.

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new release

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PRINTMASTER supports three types of screen dumps. The most flexible (★GDUMP) allows any graphics on the screen to be dumped onto the printer. This will operate in any mode, the colours being displayed as shades. Any part of the screen may be printed at any position on the paper in any one of four orientations. It is also possible to magnify the screen dump by any factor x2, x3, x4 etc.

A special feature allows true Mode 7 screen dumps with TELETEXT text and graphics, colours (as shades), double height etc.

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The above list is only a fraction of the commands in the PRINTMASTER ROM. Others include ★CENTRE, ★UNDERLINE, ★ITALIC, ★MARGIN etc. etc. which provide total control over the printer in the easiest possible manner. Order as PRINTMASTER (Epson), £28 plus £1 p&p plus VAT.

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16 Wayside, Chipperfield, Hertfordshire. WD4 9JJ Telephone: Kings Langley (09277) 69727

◄ from page 107

```
450    CMP#131:BEQ Condensed \ Code 131 = Condensed characters
460    CLC:CMP#132:BCS SuperSub \ Codes 132 & 133 affect super- & sub
-scripts
470    ;
480    .Exit LDY&32F2:LDX&32F1:LDA&32F0:RTS \ Recall Register content
s & return
490    :
500    .Underline JSR OnOrOff \ Y=1 for U/L to go on (else 0)
510    LDA#45:JSR Escape:LDA&32F3:JSR SendChar \ Sends U/L on/off com
mand
520    JMP Exit \ Terminates U/L section
530    :
540    .Emphasized JSR OnOrOff \ Check and set/reset flag
550    LDA#70:SBC&32F4:JMP Out
560    :
570    .DoubleWidth JSR OnOrOff \ Y=1 for Enlarged to go on (else 0)
580    LDA#87:JSR Escape:LDA&32F5:JSR SendChar \ Sends Enlarged comma
nd
590    JMP Exit \ Terminates Enlarged section
600    :
610    .Condensed JSR OnOrOff \ Check & set/reset flag
620    LDY&32F6:CPY#0:BEQ CondOff
630    .CondOn LDA#15:JMP Out
640    .CondOff LDA#18
650    .Out JSR Escape:JMP Exit
660    :
670    .SuperSub JSR OnOrOff \ Check &set/reset flag
680    BNE SuperSubOn:LDA#84:JSR Escape:LDA#72:JSR Escape:JMP Exit \
Switch off Super- & sub-script and cancel double printing mode
690    .SuperSubOn LDA#83:JSR Escape:SEC:LDA&32F0:SBC#132:JSR SendCha
r \ Switches on Super- or Sub-script
700    JMP Exit \ Terminates Super/Sub section
710    :
720    .Escape PHA:LDA#27:JSR SendChar:PLA:JSR SendChar:RTS \ =VDU1,2
7,1,<A>
730    :
740    .SendChar PHA:LDA#1:JSR&FFEE:PLA:JSR&FFEE:RTS \ Sends characte
r to printer
750    :
760    .OnOrOff SBC#128:TAX:LDA&32F3,X:BEQ Off \ Determines offset va
lue from code
770    .On DEC&32F3,X:RTS \ Sets Flag for OFF (was ON)
780    .Off INC&32F3,X:RTS \ Sets Flag for ON (was OFF)
790    ]
800    NEXT PASS
810 PROCZero
820 CLS:PRINT"Final Address value was &";~(P%-1)
830 :
840 REM**********************************
850 REM* BASIC Program to check m/c code *
860 REM**********************************
870 :
```

page 110 ►

printed on a single line.

Load and run the program and note the final address value that is displayed. This should be &32EF – if it is not then the assembly codes have been entered incorrectly and should be checked against the listing. When the correct final address value is displayed press in turn keys A to O and check that the text printed out is correct. Finally, when the program testing is complete, press Z to modify the assembly code to the form required by View and the block will be saved in a file called EPSON.

After entering the View facility (by typing *WORD) type PRINTER EPSON and View will load the printer driver to address &400 and will display 'Printer EPSON' in the command mode. The highlight codes 128 and 129 (underline and emphasised) correspond to the default highlight codes and represent the most frequently used facilities.

Selecting an alternative highlight code requires the use of an Edit command – for example HT 1 130 would redefine highlight 1 to select the double-width character printing facility. With View, only two highlight codes are allowed on any one line, but there is no objection to selecting a control code on a previous line as this will not be cancelled.

All control codes selected should be cancelled after use, otherwise the printer will have the relevant commands set when it is next used (the initialisation takes place only the first time the printer is used in any View printing session). The paper-end detector of the Epson is disabled by the printer driver, and you should ensure that paper is present in the printer before requesting a printout.

Some combinations of control codes are incompatible (as detailed in the Epson printer handbook on page 94) and must not be selected as they will cause unexpected effects. For example, attempting to select double-width characters and superscript (or subscript) will result in normal-height double-width characters being printed in the double printing mode.

The pad character facility is simply used by typing the £ symbol each time a fixed (or hard) space is required. For example, typing A£B£C£D ensures a printout of A B C D which would not be split by formatting or have additional spaces inserted when View justifies the text.

The £ symbol will be seen during text editing but will be replaced by a normal space when printing.

Program 1 gives access to the most useful facilities of the Epson, but some users will no doubt want access to other features which affect line spacing, and so on, and if this is done then the driver preparation program will need to be modified. The simplest technique would be to prepare a suite of driver routines with the special requirements built into them and file them as EPSON1, EPSON2, etc, calling the relevant driver file when printing text. ●

◀ *from page 109*

```
 880 REPEAT
 890   PRINTTAB(0,10)"Select Test (Keys A to O)"
 900   PRINTTAB(0,14)STRING$(10," ")
 910   PRINTTAB(0,12)"or Z to save file"'
 920   REPEAT K$=GET$:K%=INSTR("ABCDEFGHIJKLMNOZ",K$):UNTIL K%>0
 930   CALL PrinterOn
 940   IF K%=1 THEN PROCUnderline:PROCPrint:PROCUnderline
 950   IF K%=2 THEN PROCEmphasise:PROCPrint:PROCEmphasise
 960   IF K%=3 THEN PROCDoubleWidth:PROCPrint:PROCDoubleWidth
 970   IF K%=4 THEN PROCCondensed:PROCPrint:PROCCondensed
 980   IF K%=5 THEN PROCSuperscript:PROCPrint:PROCSuperscript
 990   IF K%=6 THEN PROCSubscript:PROCPrint:PROCSubscript
1000   IF K%=7 THEN PROCUnderline:PROCEmphasise:PROCPrint:PROCEmphasi
se:PROCUnderline
1010   IF K%=8 THEN PROCUnderline:PROCDoubleWidth:PROCPrint:PROCDoubl
eWidth:PROCUnderline
1020   IF K%=9 THEN PROCUnderline:PROCCondensed:PROCPrint:PROCCondens
ed:PROCUnderline
1030   IF K%=10 THEN PROCUnderline:PROCSuperscript:PROCPrint:PROCSupe
rscript:PROCUnderline
1040   IF K%=11 THEN PROCUnderline:PROCSubscript:PROCPrint:PROCSubscr
ipt:PROCUnderline
1050   IF K%=12 THEN PROCEmphasise:PROCDoubleWidth:PROCPrint:PROCDoub
leWidth:PROCEmphasise
1060   IF K%=13 THEN PROCDoubleWidth:PROCCondensed:PROCPrint:PROCCond
ensed:PROCDoubleWidth
1070   IF K%=14 THEN PROCCondensed:PROCSuperscript:PROCPrint:PROCSupe
rscript:PROCCondensed
1080   IF K%=15 THEN PROCCondensed:PROCSubscript:PROCPrint:PROCSubscr
ipt:PROCCondensed
1090   A%=13:CALL Printer:CALL Printer
1100   CALL PrinterOff
1110   UNTIL K%=16
1120 PROCSave:REM Redefine addresses and save m/c code
1130 END
1140 :
1150 REM BASIC Procedures
1160 DEFPROCSave
1170 PROCZero
1180 REM Re-assign addresses for use in page 4 (400 to 4FF)
1190 FOR I%=&3200 TO &32FF
1200   IF ?I%=&32 THEN ?I%=4
1210   NEXT I%
1220 *SAVE "EPSON" 3200 3300
1230 ENDPROC
1240 :
1250 DEFPROCZero
1260 REM Set remaining memory locations to 0
1270 FOR I%=P% TO &32FF:?I%=0:NEXT
1280 ENDPROC
1290 :
1300 DEFPROCUnderline
1310 A%=128:CALL Printer
1320 ENDPROC
1330 :
1340 DEFPROCEmphasise
1350 A%=129:CALL Printer
1360 ENDPROC
1370 :
1380 DEFPROCDoubleWidth
1390 A%=130:CALL Printer
1400 ENDPROC
1410 :
1420 DEFPROCCondensed
1430 A%=131:CALL Printer
1440 ENDPROC
1450 :
1460 DEFPROCSuperscript
1470 A%=132:CALL Printer
1480 ENDPROC
1490 :
1500 DEFPROCSubscript
1510 A%=133:CALL Printer
1520 ENDPROC
1530 :
1540 DEFPROCPrint
1550 FOR A%=65 TO 71:CALL Printer:NEXT:REM Prints ABCDEFG
1560 ENDPROC
```

ONE UP FOR BASIC

How to simulate Basic II in Basic I without changing ROMs, by David Barnett

BASIC II provides several desirable additional features, but the Basic I user can simulate many of these with functions and procedures and avoid the expense of changing the ROM. An added bonus of this approach is that the programs will run in both versions of Basic (software houses please note).

OSCLI is a very useful Basic II command. It can occur in an applications program, such as a word processor, allowing the user to give MOS printer control and other commands, for example:

```
INPUT LINE COM$
IF LEFT$(COM$,1)="*" THEN OSCLI
   (COM$)
```

If an entire data file must be loaded or saved at one step it is much faster (and on cassette more reliable) to use *SAVE than to OPEN the file and use BPUT#. In fact, Acornsoft's *Philosophor's Quest* program allows the state of the game to be saved on file in just this way. Unfortunately the filename is always "INIT". Wouldn't it be nice to allow the user to choose?

```
INPUT "SAVE FILENAME? "FILE$
OSCLI("SAVE "+FILE$+" "
+STR$~STATE%+"+"+STR$~LTH%)
```

This Basic II code does the job neatly. STATE% points to the byte-array to be saved, LTH% is the number of bytes and STR$~ converts the numbers to hex character-strings. (*SAVE and *LOAD are described on page 392 of the *User Guide).*

How can OSCLI be implemented in Basic I? The *User Guide* describes on page 463 a MOS call to the command line interpreter. The following PROCedure uses this call to create an exact substitute for the OSCLI command of Basic II:

```
DEF PROCCLI(A$)
LOCAL X%,Y%
   :REM all variables local
DIM X%-1
   :REM X% is string address
     REM (at end of variables)
Y%=X%DIV256
   :REM Y% is the high order byte
$X%=A$
   :REM store command
CALL &FFF7
   :REM call MOS routine
ENDPROC
```

There is one subtle feature of this PROCedure worth mentioning: the statement DIM X%-1 means that the procedure is completely self-contained because it allocates space for the command string only as required. When the procedure ends the space is freed. Any other dimension would leave surplus (and thereafter useless) bytes still allocated.

Basic I already has an OPENIN keyword, but it performs the same function as OPENUP in Basic II. In fact, if you take a program written in Basic I and load it into a Basic II computer, you will find when you LIST it that all the OPENINs have miraculously transformed into OPENUPs. (This is because the keyword is represented by a one-byte token - &AD - which is expanded to "OPENIN" by Basic I's LIST command, and to "OPENUP" by Basic II.)

So what is the difference? For cassette files there is no difference, but on disc (and any other system allowing random access to files) it can be important.

OPENIN opens a file for *read-only*. That is, if you then try to write to it an error will be generated. Because the file is read-only it is permissible to open it more than once (with two different 'file handles'). This latter feature can sometimes be used to improve the efficiency of file access when frequent accesses are made to widely separated parts of a file.

OPENUP, on the other hand, allows both reading and writing. As its name suggests, its purpose is to allow an existing file to be read and updated. (OPENOUT also allows both reading and writing but it always creates a new file – deleting an old one of the same name – so it is only possible to read back data written since the file was opened.)

The following function provides an exact replacement for OPENIN which can be used in Basic I. It uses the MOS call OSFIND. Note that the 'file handle' is returned in A (and not in Y, as described on pages 451 and 452 of the *User Guide.*)

```
DEF FNOPENIN(NAME$)
LOCAL X%,Y%,A%
DIM X%-1:Y%=X%DIV256
   :REM X%,Y% - address of filename
$X%=NAME$
A%=&40
   :REM code for OPENIN
=USR(&FFCE) AND &FF
   :REM MOS call returning handle
```

You might also want to define FNOPENUP so as to avoid confusion:

```
DEF FNOPENUP(NAME$)
=OPENIN(NAME$)
```

Several pseudo operations have been added to the Basic II assembler concerned with the allocation of constants. The ones of most concern to 'hybrid' Basic-assembler programmers (like me) are EQUS, EQUB and EQUD. They are used to allocate strings, bytes and four-byte words respectively. EQUS allocates a string without the CR terminator of Basic's $ operator. As an example here is the code for a BRK error message (see *User Guide*, pages 464 and 446 for an explanation):

```
BRK
EQUB 255
   ;error number
EQUS "You are an IDIOT!"
EQUD 0
```

These can be simulated with FNEQUS, FNEQUB and FNEQUD and are used as follows:

```
BRK
OPT FNEQUB(255,0)
OPT FNEQUS("You are an IDIOT!",0)
OPT FNEQUD(0,0)
```

This makes use of the only pseudo-op in Basic I (OPT) that requires a number between 0 and 3 as an argument. This is the 0 used for the second argument of each function. I do not know of a clean way to discover the existing value of OPT (ie, without PEEKing some obscure location) and so cannot make my functional substitutes totally transparent.

```
DEF FNEQUS(A$,Z):$P%=A$:P%=
P%+LENA$=Z
DEF FNEQUB(B%,Z):?P%=B%:P%=
P%+1=Z
DEF FNEQUD(W%,Z):!P%=W%:P%=
P%+4=Z
```

The Basic II OPT feature for OPT>3 for relocating the assembled code, which Paul Beverley described in *Acorn User*, May 1983, cannot be easily simulated.

Most of the Basic I bugs are fairly minor but the INSTR bug is one which I find particularly annoying. If the second argument is longer than the first some garbage is left on the basic stack. If this happens inside a PROCedure the program will crash. This function corrects the bug (with only a time penalty):

```
DEF FNINSTR(A$,B$)
IF LENA$<LENB$ THEN =0 ELSE
=INSTR(A$,B$)
```

Clearly, any other function bugs can be dealt with in like manner. Errors in the coding of control structures (such as ON . . . ELSE) cannot be dealt with, merely avoided.

Most responsible software houses will, I suspect, make sure their software runs in both Basics. If it works in Basic I it will almost certainly still work in Basic II. Those who insist on calling subroutines in the Basic ROM from their own machine code programs, however, will be in trouble because the addresses will have changed. ●

HOW TO GET FULL 12-BIT VALUE FROM YOUR ADC

Discovering that the Beeb's analogue-to-digital converter chip does not live up to its specification for scientific measurement, Paul Beverley took up the challenge of improving its accuracy.

WHEN I first saw the engineering specification for the BBC microcomputer and heard that it was to have a four-channel, 12-bit analogue-to-digital converter, I became extremely excited about the possibilities in the realm of automatic scientific measurement. Twelve bits represents a potential accuracy of 0.025% on full-scale readings, which would be more than adequate for a lot of scientific experiments. Having taken the readings, one could then get the computer to work out some results and perhaps draw a graph on the screen.

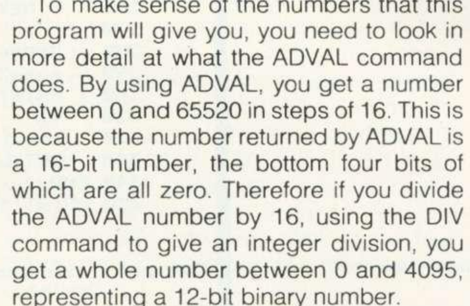


Figure 1a. Histogram of un-averaged values from the analogue to digital converter

The conversion speed seemed to be fairly slow at 10 milliseconds per channel, but at that sort of accuracy one would be prepared to put up with the relative slowness of the conversions, especially since it was to be software-switchable to a faster 8-bit conversion.

When I eventually got my hands on my first BBC micro, nearly two years ago, I was disappointed to discover that in practice the ADC system was noisy. This means that, even with a constant voltage applied to one of the channels, the value given by the ADVAL command is by no means constant. My first reaction was to try to reduce the noise level with the use of coaxial cables and by adding capacitors. Neither of these made more than a slight difference to the amount of noise on the signal.

If you want to see this for yourself, type in program 1 and run it with joysticks attached to the ADC port. You'll see that, even with a constant voltage applied, the bottom three or four bits of the 12-bit number appear to be twinkling on and off. You might have expected that with a constant input voltage you would have seen a constant binary number being produced, but no such luck!

Let's try to be a little more scientific about this. If you want to get a measure of how much random error there is in a set of scientific measurements, you first calculate the mean of the values and then work out what is known as the standard deviation of the results. Program 2 will do all the measurements and calculations for you.

To make sense of the numbers that this program will give you, you need to look in more detail at what the ADVAL command does. By using ADVAL, you get a number between 0 and 65520 in steps of 16. This is because the number returned by ADVAL is a 16-bit number, the bottom four bits of which are all zero. Therefore if you divide the ADVAL number by 16, using the DIV command to give an integer division, you get a whole number between 0 and 4095, representing a 12-bit binary number.

In all the succeeding discussion I shall refer to the ADVAL value as if it were a number between 0 and 4095. The value of the standard deviation given by program 2 gives some idea of the variation in the results obtained using this scale of values.

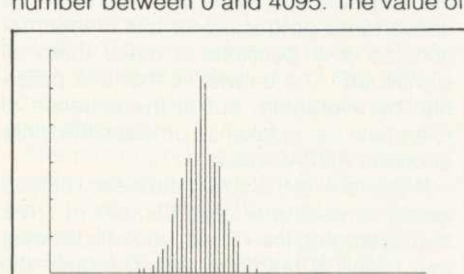


Figure 1b. Histogram of values from the analogue to digital converter when averaged in sets of four

If you run this test you will find that the value of standard deviation which it gives you varies from one end of the ADVAL range to the other. It is highest, as you might expect, at the upper end of the scale, but it does decrease slightly as you reach the extreme end of the scale, simply because you are 'hitting the stops'. As you go down the scale the value drops steadily until at the bottom end the standard deviation reaches about 60% of its maximum value. I have run this test on a number of different machines in a number of different conditions, and I generally get a maximum value for the standard deviation of somewhere between 1.8 and 2.5.

Not only does the value vary from machine to machine, and over the ADVAL range, but also it varies as the temperature of the chip changes. On a long run, starting with a cold machine, the standard deviation increased by about 15% from its 'cold' value to the steady 'warm' value which it reaches after about an hour or so, though this will obviously depend on the ambient temperature and the operating conditions.

But what is the significance of these values of standard deviation? My scientific colleagues assure me that, for a normal set of readings, about 90% of the values obtained will lie in the range covered by two standard deviations either side of the mean. In other words, for a standard deviation of 2.0 then, 90% of the time, the ADVAL value will lie within plus or minus four units of the mean (on the scale of 0 to 4095). Even so, this does not give a very clear idea of just how accurate or otherwise the ADC really is.

Let us therefore look at it from a different point of view. If the manufacturer of an ADC chip claims that his chip will produce a 12-bit conversion, then you would expect the accuracy to be plus or minus one half of the least significant bit. If we compare this with what we are getting in practice, ie, that 90% of the readings are coming within plus or minus four times the value of the least significant bit, then what we really have is only one-eighth of the accuracy we would have hoped for. In other words, the converter is giving an accuracy equivalent to only a 9-bit conversion. So where has the accuracy gone, and how can we regain it?

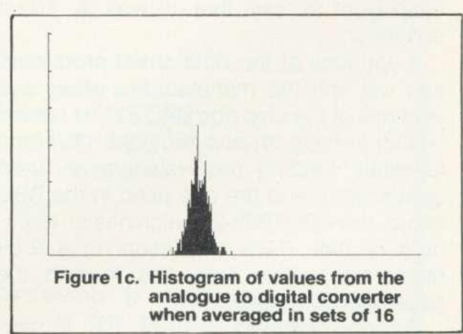


Figure 1c. Histogram of values from the analogue to digital converter when averaged in sets of 16

When I first realised how poor the accuracy was, I investigated further and discovered, by probing around the chip with an oscilloscope, that the earth line had 40 millivolts of noise on it. Now, 40 millivolts out of 1.8 volts represents an accuracy of only 5 or 6 bits. Therefore it seems fairly

```
10 INPUT"Number of bits displayed",BITS%
20 IF BITS% = 0 BITS% = 12
30 *FX16,4
40 MODE 6
50 PROCinit
60 REPEAT
70   VDU30
80   FOR N% = 1 TO 4
90     REPEAT
100      UNTIL ADVAL(0) DIV 256 = N%
110    PROCdisplay(ADVAL(N%))
120    NEXT
130   UNTIL 0
140 END
150
160 DEFPROCdisplay(M%)
170 T% = &8000
180 PRINT CHR$253;
190 FOR H% = 1 TO BITS%
200   IF(M% AND T%) VDU255 ELSE VDU32
210   T% = T%/2
220   NEXT
230 PRINT CHR$254
240 ENDPROC
250
260 DEFPROCinit
270 LOCAL N
280 VDU19;4;0;23;10,32,0;0;0;
290 N = 1
300 VDU23,253,N,N,N,N,N,N,N,N
310 N = 128
320 VDU23,254,N,N,N,N,N,N,N,N
330 N = 126
340 VDU23,255,0,N,N,N,N,N,0;
350 ENDPROC
```

Program 1. Monitoring the ADC values in binary – you can display up to 16 bits

```
10 ON ERROR GOTO 360
20 INPUT"HOW MANY SAMPLES",T%
30 goes% = 0
40 VDU12
50 *FX16,1
60 @% = 12
70 DIM V%(T%)
80 REPEAT
90   tot% = 0
100  MAX% = 0
110  MIN% = 65535
120  FOR N% = 1 TO T%
130    REPEAT UNTIL ADVAL(0) DIV256
140    K% = ADVAL1
150      IFK%>MAX% MAX% = K%
160      IFK%<MIN% MIN% = K%
170    V%(N%) = K%
180    tot% = tot% + V%(N%)
190    NEXT
200
210  mean = tot%/T%
220  sq = 0
230  FOR N% = 1 TO T%
240    di = V%(N%)-mean
250    sq = sq+di*di
260    NEXT
270
280   StDev = SQR(sq/T%)/16
290   goes% = goes%+1
300   PRINT TAB(0,goes%) mean, StDev;
310   @% = 6: PRINT MAX%,MIN%: @% = 12
320   total = total + StDev
330   UNTIL0
340 END
350 PRINT'"Average  =  "; total/goes%
```

Program 2. Calculating the mean and standard deviation of ADVAL(1)

impressive that the chip is capable of producing *as much* as a 9-bit conversion!

I have to confess that at this point I suspected that bad circuit-board layout was causing this large earth noise. However, on further investigation, I discovered that this was not the case at all. Even by improving the earth line, it made no difference to the noise on the earth line or to the standard deviation of the results. The problem lies with the chip itself. The manufacturer originally called it a 12-bit converter but later had to change the entry in its catalogue to say that it was a 10-bit converter.

If you look at the data sheet produced, you will find the manufacturer offers two versions of the chip: the UPD7002-1, which is said to have an accuracy of 0.1% of the full-scale reading (equivalent to a 10-bit conversion), and the one used in the BBC micro, the UPD7002-2, which has an accuracy of only 0.2% (representing a 9-bit conversion). This then ties in with the experimental results.

Having obtained one of the higher-specification chips, I discovered that, contrary to my expectations, it was not twice as good as the normal chip, but gave a standard deviation of approximately 1.4. I have been told that the manufacturer is at present developing a new 12-bit device which should be pin-compatible with the present chip, but there is no mention made of when it will become available or its price.

Having seen that there is a problem with the chip itself, is there any solution? The converter is producing 12 bits of information, so is it possible to make them all significant? The answer is that it is possible, by averaging, but at the expense of extra time being taken to produce the more accurate ADVAL value.

If you look at the statistical theory behind taking a reading a large number of times and averaging the values, you will discover that taking N readings should reduce the standard deviation by a factor of the square root of N. Thus by taking four readings at a time, the standard deviation on the averaged values should be one half of the original value, and if you take the averages of sets of 16 readings, you will get one quarter of the standard deviation. By taking the averages of four readings at a time, you effectively increase the accuracy from nine to 10 bits, and by taking 16 readings you increase it from nine bits to 11 bits. In order to increase it to the full 12-bit accuracy you would need to take the averages of 64 readings at a time.

The histograms in figure 1 show how averaging reduces the spread of values. Figure 1a shows what happens with no averaging at all; figure 1b shows the effect of using sets of four values, and figure 1c shows the averages of 16 readings. If you work out the standard deviations of these results, you will find that they give standard deviations which are almost exactly one half and one quarter of the original values, as predicted by the theory.

Obviously, if we were using Basic to do the averaging, it would slow down the process even more, so we need a machine code program to do the averaging for us. The versatility of the operating system on the Beeb makes it very easy to link in such a routine (note, however, that this whole idea depends on facilities which are not available in the 0.1 operating system). All you have to do is to *RUN the appropriate machine code routine from cassette or disc, the source code of which is shown as program 4, and then by using the *FX 1 command, you can switch between either normal, divide by four, or divide by 16. This is done with *FX 1,0 or *FX 1,4 or *FX 1,16.

Actually, for divide by 16 you can use any number other than 0 or 4, eg, *FX 1,1 would do. To read the averaged values, all you need do is use the original ADVAL (1), ADVAL (2) etc commands. This will give you the latest averaged value for the particular channel. If you want to be sure of catching the latest value as soon as it is averaged, then you can use:

```
REPEAT
   X% = ADVAL(0) DIV 256
   UNTIL X%
value%(X%) = ADVAL (X%)
```

or if you are using only one channel you could use:

```
REPEAT
   UNTIL ADVAL (0) DIV 256
value% = ADVAL (1)
```

In order to select how many channels are to be in use at any stage, you simply use the *FX 16 command as normal.

I have not implemented the facility for averaging by 64 to give 12-bit accuracy, firstly because it would have increased the complexity of the routines, and secondly because the time for a full averaged conversion would be 640 milliseconds, and at that sort of speed it would be fast enough to use Basic to do the averaging, using four consecutive values from the divide-by-16 averaging routine.

How then does this automatic averaging routine in program 4 actually work? The operating system can generate events when various bits of hardware interrupt the processor – such as a key having been pressed on the keyboard. The event that we want is caused by the end-of-conversion signal from the ADC. If this event is enabled by *FX 14,3 or its equivalent as an OSBYTE routine in machine code, we are then able to use the event vector (EVNTV) at &220 to point to our own routine. This is then performed as an extension to the operating system's own interrupt routine.

If you are not using averaging (ie, you have executed a *FX 1,0) then these events are still enabled, and the processor still takes a small extra time to come out through the event vector, discover that your routines are inactive and go back and carry on as before. This adds something like 0.1% to the processing time for any program that is running in the computer, but this does not seem significant. If you do want to disable these events again, you can do so with the *FX 13,3.

The routine itself has to extract the value which has just been produced by the ADC, and has been put, by the operating system, into a table of values which is later to be used by the ADVAL command. Our routine then adds this value into its running total for the particular channel, and checks whether there have been enough readings taken. If so, it divides the number by either 4 or 16, as appropriate, and puts this value back into the ADVAL table. If a set of readings has not just been completed then, before returning from the routine you have to put a value into the ADVAL table. Otherwise, using the ADVAL command would pick up the single A to D conversion value which had just been produced. Therefore we have to replace it with the previous value which was stored in a table within the routine's own working space the last time an average was completed. The program is thoroughly annotated, so you should be able to work out in detail the finer points of its operation.

All that we have said so far refers to the *relative* accuracy of the A to D converters. We have been using the internal voltage reference – the voltage drop across three silicon diodes – and a potentiometer to feed a proportion of this voltage back into the ADC input. Because we are using proportions, variations of this reference voltage are immaterial. However, if you want to measure a voltage from some piece of apparatus then you are interested in the absolute accuracy of the conversion, ie, the accuracy of the three diodes as a voltage reference. On tests that I have done, over a period of a few hours the value of the reference voltage varies by just over 6%, and only after about four hours did the value become more or less constant.

There are two ways round this problem. One is to use an external voltage reference connected to one channel with which you can do a comparison – a Weston standard cell at 1.018 volts would be quite suitable. Since the input impedance of the ADC is 10 megohms, there is no danger of damaging the cell.

The other option is to attach an external voltage reference device such as a band gap diode between Vref and analogue ground. As long as its reference voltage is less than 1.8 volts then the internal diodes will not conduct and should not affect the accuracy of the reference. I hasten to add that I have not actually tried this myself, but I have been told that it works. A suitable device would be the 9491 low current band gap device available from RS Components (Catalogue no. 283-283), costing 70p + VAT.

Obviously the ideal would be to have a true 12-bit converter which converted each channel in 10 milliseconds as suggested in the original engineering specification. Until the new chip comes on to the market we will have to be content with having to use averaging to improve the accuracy. You can use software selection of the various modes to trade off the accuracy against the measurement time. With these automatic averaging routines in operation, the options available to you are:

8-bit conversion: This takes 4 milliseconds per channel, though this speed cannot be realised in Basic since ADVAL (0) is updated only every 10 milliseconds. You use *FX 190,8 to select this mode and *FX 190,0 to switch back to normal.

9-bit conversion: This takes 10 milliseconds per channel and is the default value, but having used averaging you must then use *FX 1,0 to switch back to it.

10-bit averaged conversion: This takes 40 milliseconds per channel – use *FX 1,4.

11-bit averaged conversion: This takes 160 milliseconds per channel – use *FX 1,16 or *FX 1,1.

12-bit averaged conversion: This takes 640 milliseconds per channel – use *FX 1,16 and do your own averaging of four sets of ADVAL values. ●

*See the comments about *RUNning programs from cassette into a machine that has only just been powered up in last month's article on the Electron printer port.*

```
 10 *FX16,1
 20 DIM FREQ%(300)
 30 MODE0
 40 B% = 62000
 50 REPEAT
 60   REPEAT UNTIL ADVAL(0) DIV256
 70   S% = ADVAL(1)
 80   N% = S%-B%
 90   IF N%<0 N%=0
100   IF N%>300 N%=300
110   FREQ%(N%) = FREQ%(N%)+1
120   X% = N%*4
130   MOVE X%,0
140   DRAW X%,FREQ%(N%)*4
150   UNTIL 0
160 END
```

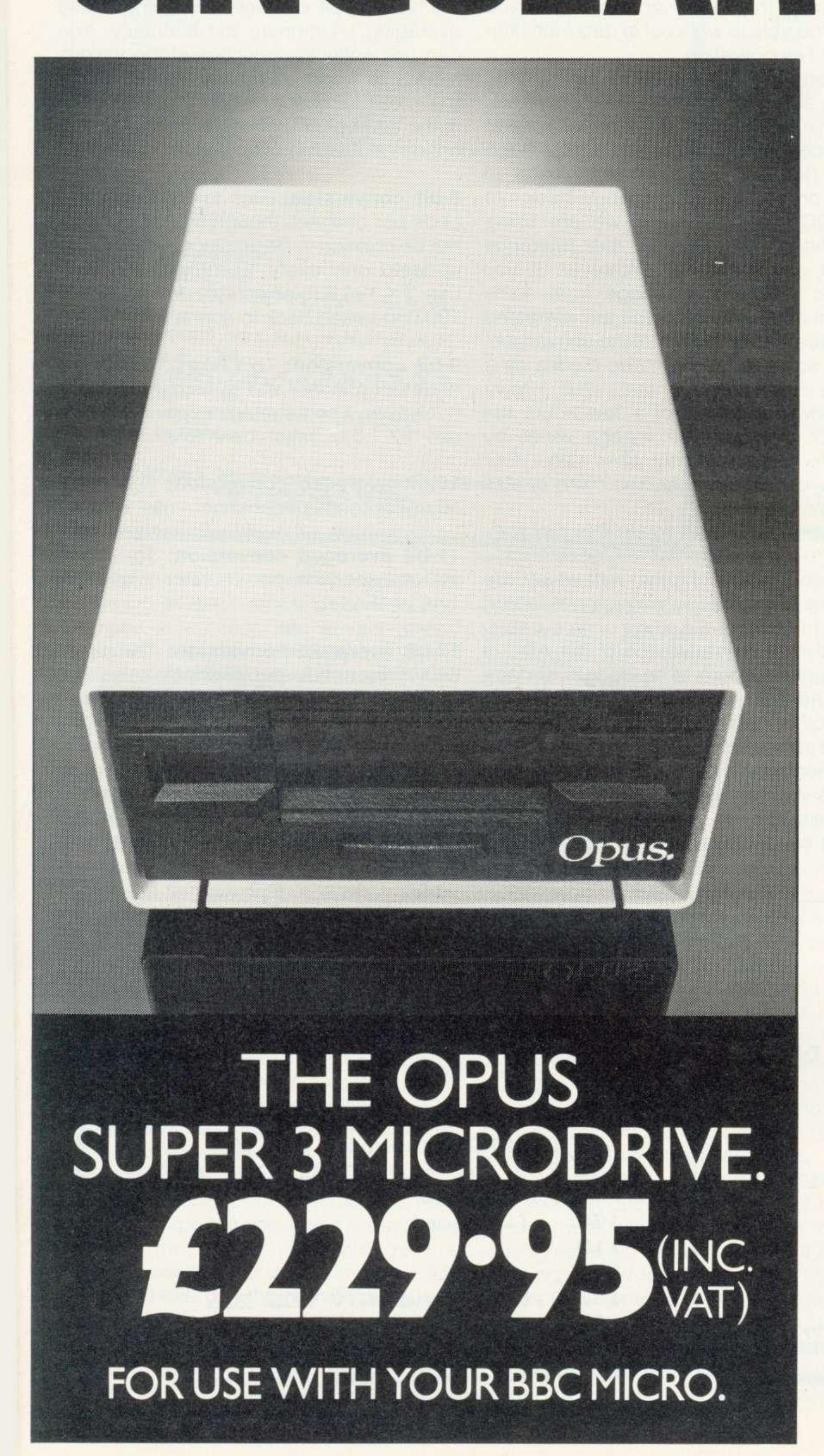
Program 3. Plots histograms of values given by ADVAL(1), irrespective of whether automatic averaging is in operation

```
 10 PROCsetup_variables
 20 PROCassemble (&C00,2)
 30 PRINT" *SAVE ADC "; ~start"
"; ~P%+1 " "; ~start
 40 CALL start
 50 END
 60
 70 DEFPROCassemble (M%,N%)
 80 FOR opt = 0 TO N% STEP N%
 90   P% = M%
100   [OPT opt
110
120   .start
130   LDA #newEVNTV MOD 256
140   STA EVNTV
150   LDA #newEVNTV DIV 256
```

Program 4. Source code for automatic averaging routine. This works only with OS 1.0 onwards ►

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```
160    STA EVNTV + 1
170    LDA #14                 \ Enable events on ADC conversion
180    LDX #3
190    JSR OSBYTE
200    RTS
210
220    .newEVNTV
230    LDA FX1flag             \ Is averaging required?
240    BEQ return
250
260    JSR add_value_to_total
270    STA channel_just_converted \ A = 0, averaging not complete
280    .return
290    RTS                     \ End of event service routine
300
310    .add_value_to_total
320    CLC
330    LDA adval_table_low,X   \ Add low byte into total
340    ADC low,X
350    STA low,X
360    LDA adval_table_high,X \ Add high byte into total
370    ADC high,X
380    STA high,X
390    BCC restore_last_value
400    INC top_byte,X          \ Only if a carry occurs
410
420    .restore_last_value
430    LDA last_value_low,X    \ Put previous averaged....
440    STA adval_table_low,X   \ value back into....
450    LDA last_value_high,X   \ table for ADVAL to read.
460    STA adval_table_high,X
470    DEC count,X             \ Count down no. of samples
480    BMI find_average        \ count < 0
490
500    LDA #0                  \ i.e. new averaged value not ready
510    RTS
520
530    .find_average
540    LDA FX1flag             \ Divide by 4 or 16?
550    CMP #4
560    BNE divide_by_sixteen   \ If not 4 then 16
570
580    .divide_by_four
590    LDA low,X               \ Calculate low byte of result
600    LSRA:LSRA
610    STA adval_table_low,X
620    LDA high,X
630    ASLA:ASLA:ASLA:ASLA:ASLA:ASLA
640    ORA adval_table_low,X
650    STA adval_table_low,X   \ Store in ADVAL table
660    STA last_value_low,X    \ Store also as "previous value"
670
680    LDA high,X              \ Calculate high byte of result
690    LSRA:LSRA
700    STA adval_table_high,X
710    LDA top_byte,X
720    ASLA:ASLA:ASLA:ASLA:ASLA:ASLA
730    ORA adval_table_high,X
740    STA adval_table_high,X \ Store in ADVAL table
750    STA last_value_high,X  \ Store also as "previous value"
```

◄

```
760   LDA #3
770   BNE reset_totals
780
790   .divide_by_sixteen
800   LDA low,X     \ See above - divide by 4
810   LSRA:LSRA:LSRA:LSRA
820   STA adval_table_low,X
830   LDA high,X
840   ASLA:ASLA:ASLA:ASLA
850   ORA adval_table_low,X
860   STA adval_table_low,X
870   STA last_value_low,X
880
890   LDA high,X
900   LSRA:LSRA:LSRA:LSRA
910   STA adval_table_high,X
920   LDA top_byte,X
930   ASLA:ASLA:ASLA:ASLA
940   ORA adval_table_high,X
950   STA adval_table_high,X
960   STA last_value_high,X
970
980   LDA #15
990   .reset_totals
1000  STA count,X  \ Reset count value
1010  LDA #0     \ Zero all totals
1020  STA low,X
1030  STA high,X
1040  STA top_byte,X
1050  TXA     \ Channel just converted in acc
1060  RTS
1070  ]
1080
1090  count = P%
1100  low = P%+4
1110  high = P%+8
1120  top_byte = P%+12
1130  last_value_low = P%+16
1140  last_value_high = P%+20
1150  NEXT
1160 ENDPROC
1170
1180 DEFPROCsetup_variables
1190 adval_table_low = &2B5
1200 adval_table_high = &2B9
1210 channel_just_converted = &2BE
1220 FX1flag = &281
1230 EVNTV = &220
1240 OSBYTE = &FFF4
1250 ENDPROC
```

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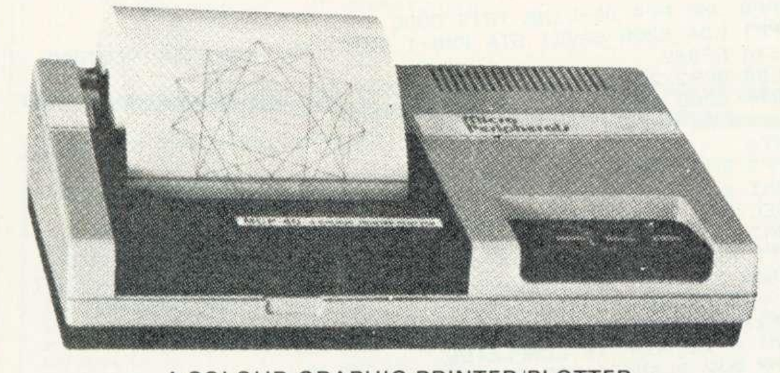
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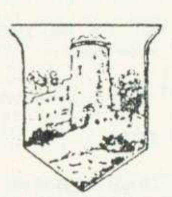
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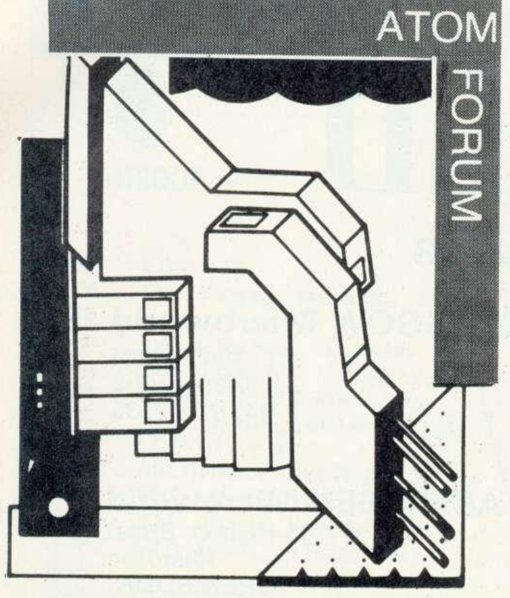
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What we're looking for are those little routines, tips and hardware mods you've discovered. Don't worry if your little wrinkle seems too simple – it's probably just what someone else has been looking for. The same rules apply here as in Beeb Forum. Short, sweet and as original as possible is the name of the game.

Send your ideas to Atom Forum, Acorn User, 53 Bedford Square, London WC1B 3DZ. If you want it returned, enclose a SAE. It should be typed or printed and any program should be sent on cassette (with listing if possible).

EASY-TO-READ ASSEMBLER LISTINGS

£20

by D P Tweed

ANYBODY who writes much machine code will be aware of the importance of comments. It is also helpful to arrange for the assembler listing to be tabulated for ease of reading. Although tabulation can be achieved by padding the source code with spaces, it can be very tedious to key in, and it takes up a lot of space in the source file, which makes both saving and loading time-consuming.

A solution to these drawbacks is suggested here. It takes the form of a short machine-code routine which intercepts the print data coming from the assembler, and treats any spaces as tab codes, padding out the fields to a fixed length, except when in the comments field or the 'preamble'.

It is usual to express lines of source code as shown in figure 1.

Each line of printed output from the assembler has the format in figure 2.

It consists of a 20-byte 'preamble', followed by whatever was typed in for that source-code line.

Thus, using this machine code routine, the tabulated listing shown in figure 1 would be produced from the following source code.

10:LL1 STA LL2 SAVE CONTENTS OF 'A'; STA LL3; TXA MOVE 'X'

This is a considerable saving of file space and effort over manual tabulation.

In line 10 of listing 1, M is set to the address where the routine will be assembled; L is set to the number of the highest label.

In line 1000, !PP5 sets the width of the label, operation and operand fields to 6,4 and 9 respectively.

Once the routine is in memory, link to PP1 before running any assemblies; link to PP0 to remove the linkage when the assembly is finished. These commands can be placed in the Basic surrounding the machine code.

If you happen to use a printer driver other than the Atom's, link that routine in first. This ensures that any print data is sent to your routine for printing.

```
> >LIST
  10M=£3000;L=12
  20DIMPPL;F.X=0TOL;PPX=M;N.
  30P.$21$3;GOS.95
  40P.$2
  50GOS.95;P.$6$3;E.
  95P=M;[
 100:PP0 JMP PP4 DE-LINK THIS CODE
 110:PP1 LDA £208 SAVE; STA PP8+1 EXISTING; LDA £209 VECTORS
 115 STA PP8+2
 120 LDA @PP2/256 RE-DIRECT; STA £209 O/P TO; LDA @PP2&255 PP2
 125 STA £208 AND; RTS  BACK TO BASIC
 130:PP4 LDA PP8+1 .; STA £208 .; LDA PP8+2 DE-LINK; STA £209 .
 135 RTS
 140:PP2 PHP  SAVE STATUS; STX £E4 AND X; CMP @32 PRINTABLE?
 145 BMI PP3 NO
 150 DEC PP6 DECREMENT PREAMBLE COUNTER
 155 BMI PP10 JUMP IF NOT IN PREAMBLE:ELSE PASS DATA THROUGH
 160:PP9 LDX £E4 RESTORE; PLP  ENVIRONMENT; JMP (PP8+1) & EXIT
 175\   IF COMMENT FIELD
 170:PP10 LDX PP7 GET FIELD COUNTER; BEQ PP9 PASS THROUGH
 180:PP11 DEC PP5 DECREMENT CURRENT FIELD LENGTH
 185 BMI PP12 JUMP IF COMPLETED
 190 CMP @32 BLANK?; BNE PP9 NO-PRINT WHATEVER IT IS
 200:PP8 JSR 65535 PRINT A BLANK(CORRECT ADDRESS IS SET BY INIT)
 210 JMP PP11 UNTIL TAB FIELD COUNTER=-1
 220:PP12 DEC PP7 DEC FIELD COUNTER; LDX PP7 AND USE AS AN INDEX
 230 LDA PP5,X TO GET NEXT; STA PP5 FIELD LENGTH; LDA @32
 235 JMP PP9 PRINT LAST BLANK OF FIELD
 240:PP3 LDX @3; STX PP7 INITIALIZE FIELD COUNTER; PHA  SAVE A
 245 LDA PP5,X GET LABEL FIELD LENGTH
 250 STA PP5 AND SET PP5; PLA  RESTORE A; LDX @20 INIT
 260 STX PP6 PREAMBLE COUNT; BNE PP9
 270:PP5 BRK  CURRENT.FIELD LENGTH; BRK  OPERAND FIELD LENGTH
 280 BRK  OPERATION FIELD LENGTH; BRK  LABEL FIELD LENGTH
 290:PP6 BRK  PREAMBLE COUNTER;:PP7 BRK  FIELD COUNTER
1000];!PP5=£06040900;!PP6=£314;REM SET UP DEFAULT CONSTANTS
2000R.
```

Listing 1. The source code (£=#)

DISC DELIGHT

IN THE December issue Vincent Fojut showed you how the Atom and Beeb may be made to communicate. If you have the Atom disc pack, program transfer is surprisingly easy.

As noted in issue 2 of *Acorn User*, the DOS supports *SPOOL and *EXEC. The former creates an ASCII file on disc just by typing LIST – this is untokenised. *EXEC reads such a file from disc as if it had been typed from the keyboard, and the Beeb will tokenise it in the normal way. The disc format is identical on the Atom and BBC DOS (40 track) so, by using these two commands, the Atom will read Beeb discs and vice-versa.

If the Atom file was written in BBC Basic, the Beeb will be able to execute it, otherwise it will flag an error. However, an AtomBasic program will still be there and may be listed, so that conversion can be attempted.

Note that text files created using Atom's Wordpack or the Beeb's View are already in ASCII format and you may transfer from one machine to the other by using the normal load commands. However, you should remove all formatting commands, before saving to disc.

label	operation	operand	comments
LL1	STA	LL2	SAVE CONTENTS OF 'A'
	STA	LL3	
	TXA		MOVE 'X'

Figure 1. Source code in fields

```
line no   addr   machine code
xxxxx     xxxx   xx xx xx      :LL1     STA     LL2     SAVE CONTENTS
                                                        OF 'A'
          Preamble
```

Figure 2. Assembler output format

```
   95 3000
  100 3000 4C 1A 30 :PP0 JMP PP4 DE-LINK THIS CODE
  110 3003 AD 08 02 :PP1 LDA £208 SAVE
  110 3006 8D 48 30  STA PP8+1 EXISTING
  110 3009 AD 09 02  LDA £209 VECTORS
  115 300C 8D 49 30  STA PP8+2
  120 300F A9 30     LDA @PP2/256 RE-DIRECT
  120 3011 8D 09 02  STA £209 O/P TO
  120 3014 A9 27     LDA @PP2&255 PP2
  125 3016 8D 08 02  STA £208 AND
  125 3019 60        RTS  BACK TO BASIC
  130 301A AD 48 30 :PP4 LDA PP8+1 .
  130 301D 8D 08 02  STA £208 .
  130 3020 AD 49 30  LDA PP8+2 DE-LINK
  130 3023 8D 09 02  STA £209 .
  135 3026 60        RTS
  140 3027 08       :PP2 PHP  SAVE STATUS
  140 3028 86 E4     STX £E4 AND X
  140 302A C9 20     CMP @32 PRINTABLE?
  145 302C 30 30     BMI PP3 NO
  150 302E CE 76 30  DEC PP6 DECREMENT PREAMBLE COUNTER
  155 3031 30 06     BMI PP10 JUMP IF NOT IN PREAMBLE:ELSE
                     PASS DATA THROUGH
  160 3033 A6 E4    :PP9 LDX £E4 RESTORE
  160 3035 28        PLP  ENVIRONMENT
  160 3036 6C 48 30  JMP (PP8+1) & EXIT
  170 3039 AE 77 30 :PP10 LDX PP7 GET FIELD COUNTER
  170 303C F0 F5     BEQ PP9 PASS THROUGH
  175 303E          \   IF COMMENT FIELD
  180 303E CE 72 30 :PP11 DEC PP5 DECREMENT CURRENT
                     FIELD LENGTH
  185 3041 30 0A     BMI PP12 JUMP IF COMPLETED
  190 3043 C9 20     CMP @32 BLANK?
  190 3045 D0 EC     BNE PP9 NO-PRINT WHATEVER IT IS
  200 3047 20 FF FF :PP8 JSR 65535 PRINT A BLANK(CORRECT
                     ADDRESS IS SET BY INIT)
  210 304A 4C 3E 30  JMP PP11 UNTIL TAB FIELD COUNTER=-1
  220 304D CE 77 30 :PP12 DEC PP7 DEC FIELD COUNTER
  220 3050 AE 77 30  LDX PP7 AND USE AS AN INDEX
  230 3053 BD 72 30  LDA PP5,X TO GET NEXT
  230 3056 8D 72 30  STA PP5 FIELD LENGTH
  230 3059 A9 20     LDA @32
  235 305B 4C 33 30  JMP PP9 PRINT LAST BLANK OF FIELD
  240 305E A2 03    :PP3 LDX @3
  240 3060 8E 77 30  STX PP7 INITIALIZE FIELD COUNTER
  240 3063 48        PHA  SAVE A
  245 3064 BD 72 30  LDA PP5,X GET LABEL FIELD LENGTH
  250 3067 8D 72 30  STA PP5 AND SET PP5
  250 306A 68        PLA  RESTORE A
  250 306B A2 14     LDX @20 INIT
  260 306D 8E 76 30  STX PP6 PREAMBLE COUNT
  260 3070 D0 C1     BNE PP9
  270 3072 00       :PP5 BRK  CURRENT FIELD LENGTH
  270 3073 00        BRK  OPERAND FIELD LENGTH
  280 3074 00        BRK  OPERATION FIELD LENGTH
  280 3075 00        BRK  LABEL FIELD LENGTH
  290 3076 00       :PP6 BRK  PREAMBLE COUNTER
  290 3077 00       :PP7 BRK  FIELD COUNTER
```

Listing 2. The assembler output obtained by running the program

```
   95 3000
  100 3000 4C 1A 30 :PP0   JMP  PP4        DE-LINK THIS CODE
  110 3003 AD 08 02 :PP1   LDA  £208       SAVE
  110 3006 8D 48 30        STA  PP8+1      EXISTING
  110 3009 AD 09 02        LDA  £209       VECTORS
  115 300C 8D 49 30        STA  PP8+2
  120 300F A9 30           LDA  @PP2/256   RE-DIRECT
  120 3011 8D 09 02        STA  £209       O/P TO
  120 3014 A9 27           LDA  @PP2&255   PP2
  125 3016 8D 08 02        STA  £208       AND
  125 3019 60              RTS             BACK TO BASIC
  130 301A AD 48 30 :PP4   LDA  PP8+1      .
  130 301D 8D 08 02        STA  £208       .
  130 3020 AD 49 30        LDA  PP8+2      DE-LINK
  130 3023 8D 09 02        STA  £209       .
  135 3026 60              RTS
  140 3027 08       :PP2   PHP             SAVE STATUS
  140 3028 86 E4           STX  £E4        AND X
  140 302A C9 20           CMP  @32        PRINTABLE?
  145 302C 30 30           BMI  PP3        NO
  150 302E CE 76 30        DEC  PP6        DECREMENT PREAMBLE COUNTER
  155 3031 30 06           BMI  PP10       JUMP IF NOT IN PREAMBLE
                                          :ELSE PASS DATA THROUGH
  160 3033 A6 E4    :PP9   LDX  £E4        RESTORE
  160 3035 28              PLP             ENVIRONMENT
  160 3036 6C 48 30        JMP  (PP8+1)    & EXIT
  170 3039 AE 77 30 :PP10  LDX  PP7        GET FIELD COUNTER
  170 303C F0 F5           BEQ  PP9        PASS THROUGH
  175 303E                                 IF COMMENT FIELD
  180 303E CE 72 30 :PP11  DEC  PP5        DECREMENT CURRENT
                                           FIELD LENGTH
  185 3041 30 0A           BMI  PP12       JUMP IF COMPLETED
  190 3043 C9 20           CMP  @32        BLANK?
  190 3045 D0 EC           BNE  PP9        NO-PRINT WHATEVER IT IS
  200 3047 20 FF FF :PP8   JSR  65535      PRINT A BLANK(CORRECT
                                           ADDRESS IS SET BY INIT
  210 304A 4C 3E 30        JMP  PP11       UNTIL TAB FIELD COUNTER=-1
  220 304D CE 77 30 :PP12  DEC  PP7        DEC FIELD COUNTER
  220 3050 AE 77 30        LDX  PP7        AND USE AS AN INDEX
  230 3053 BD 72 30        LDA  PP5,X      TO GET NEXT
  230 3056 8D 72 30        STA  PP5        FIELD LENGTH
  230 3059 A9 20           LDA  @32
  235 305B 4C 33 30        JMP  PP9        PRINT LAST BLANK OF FIELD
  240 305E A2 03    :PP3   LDX  @3
  240 3060 8E 77 30        STX  PP7        INITIALIZE FIELD COUNTER
  240 3063 48              PHA             SAVE A
  245 3064 BD 72 30        LDA  PP5,X      GET LABEL FIELD LENGTH
  250 3067 8D 72 30        STA  PP5        AND SET PP5
  250 306A 68              PLA             RESTORE A
  250 306B A2 14           LDX  @20        INIT
  260 306D 8E 76 30        STX  PP6        PREAMBLE COUNT
  260 3070 D0 C1           BNE  PP9
  270 3072 00       :PP5   BRK             CURRENT FIELD LENGTH
  270 3073 00              BRK             OPERAND FIELD LENGTH
  280 3074 00              BRK             OPERATION FIELD LENGTH
  280 3075 00              BRK             LABEL FIELD LENGTH
  290 3076 00       :PP6   BRK             PREAMBLE COUNTER
  290 3077 00       :PP7   BRK             FIELD COUNTER
```

Listing 3. The assembler output of the program after linking in the tabulator program

EASING INTO THE UPPER TEXT AREA

LARGE Basic programs can be troublesome on the Atom, with its limited memory. One way of overcoming this is to use the upper text (graphics) area and AT&P shows you how to switch memory areas. However, if your programs do a lot of jumping about to different routines, keeping track of which area you are supposed to be in is by no means easy.

Listing 4 provides the answer. It uses 52 bytes of machine code and, once assembled, allows you to type in programs as if both areas of memory were one. When you get an error 248 (out of memory), simply move to the upper text area and carry on as if nothing had happened.

Before running your enlarged program, line 10 (without P.$21!) must be entered to activate the routine. What it does is to intercept the error routine and checks for errors 127 or 157 (line no./label not found). Any other error will cause the Atom to act as normal, but error 127/157 will first switch text spaces and try to find the line number or label there. Naturally, if it still can't find it, it gives up and signals an error. Once activated, its use is quite transparent.

To demonstrate, assemble the routine and enter lines 400 onwards in the lower text area. Then move to the upper text area and enter the following short program:

```
10REM Demo – Part 2
20a P."UPPER TEXT AREA" '
30 G.445
600 P."UPPER TEXT AGAIN" '
610 R.
```

```
1REM    Listing 4
2REM
4REM xxxxxxxxxxxxxxxxxxx
5REM-xx Memory Link  xx
6REM xxxxxxxxxxxxxxxxxxx
7REM
10?£202=£CA;?£203=£28;P.$21
20DIMLL7;F.N=0TO1;P=£28CA
25Q=P
30[
40:LL0        \ Start
50PLA;PLA:CMP@127;BEQ LL1
60CMP@157;BEQ LL1
70JMP£C9DA
80:LL1 LDY@4;\ Mainloop
90:LL3 DEY
100:LL5
110DEC £5;LDA £5
120CMP@£FF;BNE LL2;DEC£6
130:LL2 CPY@0;BNE LL3
140LDA(£5),Y
150CMP@£3B;BEQ LL4
160CMP@£D;BNE LL5
170:LL4 LDA@£82
180CMP £12;BNE LL6
190LDA@£29
200:LL6
210STA £12
220JMP£C3C4   \ Back to basic
230];N.;P.$6;R=P
240REM
250REM======================
399REM    Demo
400P.$12;F.N=1TO2
410P."LOWER TEXT AREA"'
420GOS.600
430P."BACK DOWN AGAIN"'
440G.a
445N.;@=0
450P."FINALLY,BACK DOWN"'
460P.'"TO SAVE CODE:"'
470P."*SAVE ""MEMLINK"""
480P.&Q" "&R'
490@=8;E.
500REM=====================
```

Listing 4. Accessing the upper text area without losing track (£=#)

AH... LISTO!

Vincent Fojut presents a 'pretty printing' listing formatter for the Atom, modelled on the Beeb's LISTO facility. It even goes one (or two) better – and all in less than 256 bytes!

FORMATTED listing, or 'pretty printing', as it is popularly called, is an integral part of the structured programming philosophy. Many modern 'structured' languages, such as Comal and BBC Basic, have in-built formatting options (eg, LISTO), intended to clarify a program's logical sequence and generally aid legibility.

Now Atom owners can get in on the act. Here is a program which not only emulates the BBC's LISTO facility, but also provides a useful extra formatting option of its own. Multi-statement lines can now be listed as one statement per line, each with the appropriate level of indentation. The full range of options available is listed in table 1.

For reasons of size, the program is written in assembler. Once the program listing is entered and run, the resultant machine code can, of course, be saved and loaded independently, and conveniently fits within one page of memory.

Six ROM-based routines are used by the program. The first, at #CEA1, sets the 'text pointer' at #58, #59 to the start of a new line, and also checks if the escape key is pressed, to allow listing to be terminated in the usual way. The second routine, at #C589, prints the 32-bit value on the top of the Atom's workspace stack, at locations #16, #25, #34 and #43. Here it is used to print line numbers.

The other four routines are as follows:

#F7FD – print a space

#FFF4 (OSWRCH) – print ASCII character in accumulator

#FFED (OSCRLF) – issue carriage return, line feed

#FFE9 (OSASCI) – if CR, call OSCRLF, else call OSWRCH

Once each line number has been printed, the formatting routine checks if a space is to be printed. If the appropriate option bit is set to 1, and providing the next character is not a label, a space is printed. The start of each statement is examined for any of the 'loop control' words – FOR, NEXT, DO, UNTIL and FUNTIL (floating-point UNTIL).

If one is detected, the indentation level, used in formatting, is incremented or decremented as necessary. Providing an 'indent loop' option is requested, each line printed is indented by an amount dependent on the above indentation level parameter. If a 'statement per line' option is in force, then each statement is printed on a new line, indented by the correct amount. The formatting routine continues to process each line in turn, until the end of the program is detected, marked by a #D followed by a negative-value byte.

The program uses the Basic variable 'L' to signify the listing option required (only the lowermost four bits are examined). The options may be selected either singly or in combination. This gives a total of 16 different formatting variations. For instance, to indent both 'FOR...NEXT' loops (option 2) and 'DO...UNTIL' loops (option 4) set L=6 (6=2+4).

To avoid confusing those who also use the BBC micro, 'L=0' to 'L=7' have the same effect as LISTO0 to LISTO7. The new options of 'L=8' to 'L=15' duplicate the above, but also have each statement printed on a separate line. For example, to imitate the BBC's sequence of 'LISTO7' followed by 'LIST', you would enter 'L=7' followed by 'LINK LL0' (where LL0 is the address at which the machine code is assembled – all future examples assume an address of #2800). The formatter automatically lists any program in the text space currently selected – whether upper or lower.

Example 1 shows the Atom 'Pretty Print-

a)

```
 100REM FORMATTING EXAMPLE
 110aF.X=1 TO 2;P.X;N.
 120DO
 130FOR A=B TO C
 140PRINT A;D=D+1
 150NEXT
 160X=X+1
 170UNTIL X=10;END
```

b)

```
 100 REM FORMATTING EXAMPLE
 110aF.X=1 TO 2;P.X;N.
 120 DO
 130   FOR A=B TO C
 140     PRINT A;D=D+1
 150   NEXT
 160   X=X+1
 170 UNTIL X=10;END
```

c)

```
 100 REM FORMATTING EXAMPLE
 110aF.X=1 TO 2;
       P.X;
     N.
 120 DO
 130   FOR A=B TO C
 140     PRINT A;
         D=D+1
 150   NEXT
 160   X=X+1
 170 UNTIL X=10;
     END
```

Example 1. Formatting in action: a) L=0 (or normal 'LIST'); b) L=7; c) L=15

er' in action, with probably the two most useful options, 7 and 15. Note that the program correctly indents FOR...NEXT and DO...UNTIL statements, with the respective key words on the same level, unlike the Beeb. For example:

BBC indentation
```
FOR A=B TO C
  PRINT A
  NEXT
```
Atom indentation
```
FOR A=B TO C
  PRINT A
NEXT
```
If your indentation appears odd during formatting, check for leading spaces at the beginning of statements in your program text. The formatter makes such spaces redundant, and you can save memory by deleting them.

Although the program is largely imitative of the BBC's LISTO function, a number of important differences between Atom Basic and BBC Basic needed to be considered. First of all, Atom Basic supports the use of labels (lower-case characters a-z) as targets in GOTO and GOSUB statements, whereas BBC Basic does not. Labels must always immediately follow the line number, without any intervening spaces. Therefore, if option 1 is selected (singly or in combination), a space is printed after a given line number only if the line is not labelled. This avoids the risk of causing confusion or encouraging bad programming habits.

Another major difference between Acorn's Basics is that while the BBC version is held in tokenised form, the Atom dialect is held (more or less) as entered. Consequently, any formatting program on the Beeb need only search for the single-byte tokens for certain statements (eg, FOR, NEXT, REPEAT and UNTIL are held respectively as &E3, &ED, &F5 and &FD). By contrast, the Atom formatter needs to search for, and match against, complete ASCII strings. To complicate matters, most Atom Basic commands can be abbreviated by the use of a period '.'. For example, our Pretty Printing routine needs to recognise five different forms of the 'UNTIL' statement – U., UN., UNT., UNTI., and UNTIL – all of which are valid.

Furthermore, the all-embracing 'REPEAT...UNTIL' construct on the Beeb has two distinct counterparts on the Atom. 'DO...UNTIL' can test integer conditions, while 'DO...FUNTIL', available with Acorn's FP ROM, is needed to test floating-point conditions. That is:

```
DO A=A+1, UNTIL A=B
```
but
```
DO %A=%A+1; FUNTIL %A=%B
```
The Atom formatter will detect both variants of the DO...UNTIL loop.

A considerable amount of effort has been spent in ensuring that the final program occupies less than 256 bytes, so that it can fit within locations #2800 to #28FF. This is, of course, the usual place for user-supplied machine-code on the Atom, out of the way of normal Basic text-space. If your program has other uses for this area – for example, floating-point variables – then the machine code can easily be assembled at another location.

In order to keep the program size within the above limits, a couple of assumptions were made to avoid overcomplex processing. Firstly, the semicolon character ';' is considered to be a statement delimiter, wherever it occurs. In fact, this is virtually always true, but there are a couple of exceptions. If you chose a 'statement per line' option (L=8 to L=15), you should not have semicolons within REM statements or quotes.

OPTION VALUE *(assigned to Basic var. 'L')*	FUNCTION
0	'Normal', unmodified listing
1	Print a space after each line no.
2	Indent FOR...NEXT loops
4	Indent DO...UNTIL & DO... FUNTIL loops
8	Print multi-statement lines as one statement per line

Table 1. Formatting options available

In addition, the formatting program expects any occurrence of the loop words – FOR, NEXT, DO and (F)UNTIL – to be at the very beginning of a statement. Again, this is nearly always the case. The exceptions are that 'DO' or 'FOR' could occur within an 'IF' statement or another 'DO' statement. For example:

```
IF A=B DO P.A ...
```
or
```
DO FOR A=B TO C;...
```
Fortunately, there is a simple solution in these cases. We can ensure that the 'DO' and 'FOR' are the first words in a statement by prefixing them with a semicolon, thus;

```
IF A=B;DO P.A ...
```
or
```
DO; FOR A=B TO C,...
```
These are functionally identical to the earlier examples, and are correctly handled by the formatter. Note, of course, that NEXT and UNTIL must always occur at the beginning of a statement, without exception.

There are a number of advantages in being able to list a program using 'LINK', as opposed to 'LIST'. Since LINK is a statement, not a command, it may be used in both direct-mode and programs. Example 2 gives some of the possibilities, including programs which will list themselves when run!

Finally, it should be emphasised that the Atom formatter alters only the way in which a program is listed on the screen or printer. It does not add to, or modify your program text in any way, so there is no danger of corrupting your program by using the routine. Feel free to experiment! ●

```
a)

F.L=0 TO 15;P.''"OPTION "L'';LINK #2800;N.

b)

P.$2;L=7;F.N=1 TO 3;LINK#2800;P.''';N.;P.$3

c)

10REM SELF-LISTING PROGRAM
20P."THE BEGINNING"''
30L=15;LINK #2800
40P."THE END"'''
50END
```

Example 2. Advantages of 'LINK' over 'LIST': a) List programs in all possible formats; b) issues multiple copies of listing onto printer; c) a program which lists itself when run

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Program 1. Atom listing formatter

```
100 REM *** ATOM PRETTY PRINTING ***
110 REM   PRODUCES FORMATTED ATOM
120 REM   LISTINGS, WITH 4 OPTIONS,
130 REM   (IN ANY COMBINATION) :-
140 REM 1/ SPACE AFTER LINE No.s
150 REM 2/ "FOR..NEXT" LOOPS INDENTED
160 REM 3/ "DO..UNTIL" LOOPS INDENTED
170 REM 4/ ONE STATEMENT PER LINE
180 REM
190 REM (C) V. FOJUT 1983.
200 REM
210 DIM LL29, TT2, L1
220 FOR N=0 TO 35; LLN=-1; NEXT
230 FOR N=0 TO 2; TTN=-1; NEXT
240 T=#58; REM TEXT POINTER
250 IN."ASSEMBLE FROM (#)" H
260 IN."LIST ASSEMBLY (Y/N)" $L
270 IF $L="N" P.$21
280 FOR N=1 TO 2
290 P=H
300 [:LL0
310   LDY @0     \zeroise text-ptr.
320   STY #80    \& "indent level".
330   STY #83    \"last char printed"
340   STY T      \set up text base
350   LDA 18     \address.
360   STA T+1
370   LDA @5     \set field width
380   STA #321   \for line nos.
390 \
400 :LL1 \new line process
410   JSR #CEA1 \add Y to text ptr.
420   LDA (T),Y \get next char.
430   BMI LL10  \end of prog: exit.
440   STA #25   \else store lineno.
450   INY
460   LDA (T),Y
470   STA #16
480   JSR #C589 \print line no.
490   LDY @3
500   LDA (T),Y \is next char
510   CMP @#61  \a label?
520   BCC LL12  \jump if not
530   JSR #FFF4 \else print label.
540   JMP LL11
550 \
560 :LL12
570   DEY
580 :LL2 \new statement process
590   LDA #32D  \lo-byte of "L".
600   LSR A     \space option?
610   BCC LL11  \jump if not
620   JSR #F7FD \else print space.
630 :LL11
640   INY
650   STY #81    \save text-ptr.
660   DEY
670 :LL4
680   INY        \scan for 1st
690   LDA (T),Y \non-space
700   CMP @32    \char.
710   BEQ LL4
720   JSR LL14   \"special" word?
730   LDY #81
740   BCS LL8    \jump if not.
750 \
760 \ reserved word detected. value
770 \ of X specifies word.
780 \
790   LDA TT0,X \get logic mask.
800   AND #32D  \approp. indent optn?
810   BEQ LL8   \jump if not.
820   CPX @2    \"UNTIL" or "NEXT"?
830   BCS LL7   \jump if so.
840   JSR LL20  \print statement.
850   INC #80   \incr.indent level.
860   JMP LL9
870 :LL7
880   DEC #80   \decr.indent level.
890   BPL LL8   \cater for "UNTIL
900   INC #80   \without DO" etc.
910 :LL8
920   JSR LL20  \print statement
930 :LL9
940   BCC LL1   \get next line,
950   LDA #32D  \else next statement
960   AND @8    \printing space
970   BNE LL2   \if required.
980   BEQ LL11
990 \ end of program - exit.
1000 :LL10
1010   RTS
1020 \
1030 \ check for reserved words
1040 \ DO, FOR, UNTIL, NEXT
1050 \ & also FUNTIL.
1060 \
1070 :LL14
1080   LDX @4     \index for look-up
1090 :LL15
1100   DEX        \table.
1110   BMI LL19   \words not found.
1120   CMP TT1,X \does 1st char match?
1130   BNE LL15   \repeat if not.
1140 \possible match: check if FUNTIL
```

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```
1150    CPX @1      \"F" detected?
1160    BNE LL16   \jump if not
1170    INY         \else check
1180    LDA (T),Y  \if next char
1190    CMP @CH"U"\ = "U". if so,
1200    BEQ LL14   \do UNTIL check.
1210    DEY
1220 \
1230 \ check for rest of word.
1240 \
1250 :LL16
1260    STX #82    \save X
1270    LDA TT2,X  \get word offset.
1280    TAX
1290 :LL17
1300    INX          \check
1310    INY          \each
1320    LDA #C097,X  \char.
1330    BMI LL18     \word matches.
1340    CMP (T),Y
1350    BEQ LL17
1360    LDX #82    \if D, exit."DO" cant
1370    BEQ LL19   \be abbreviated.
1380    LDA (T),Y  \check for
1390    CMP @CH"."\abbreviation.
1400    BNE LL19   \jump if none.
1410 :LL18
1420    LDX #82     \X indicates word.
1430    CLC         \clear carry
1440    RTS         \(=word found).
1450 :LL19
1460    SEC         \set carry
1470    RTS         \(=word not found).
1480 \
1490 \ Print statement
1500 :LL20
1510    JSR LL24    \Print statement
1520                \with any indents.
1530    BCC LL23    \exit if end of line.
1540 \ end of statement.
1550    LDA #32D    \"statement Per line"
1560    AND @8      \ option?
1570    BEQ LL22    \exit if not.
1580    JSR #FFED   \do CR/LF.
1590    LDX @5
1600 :LL21
1610    JSR #F7FD   \Print
1620    DEX         \five
1630    BNE LL21    \sPaces
1640 :LL22
1650    SEC         \e.o.statement
1660 :LL23
1670    RTS
```

```
1680 \
1690 \ Print indents, if any.
1700 :LL24
1710    LDA #83     \last char Printed
1720    CMP @#3B    \semicolon?
1730    BNE LL25    \no: begin.of line
1740    LDA #32D    \"statement Per line"
1750    AND @8      \oPtion?
1760    BEQ LL27    \jump if not.
1770 :LL25
1780    LDA #80     \check indent level.
1790    BEQ LL27    \jump if none.
1800    ASL A       \Print 2
1810    TAX         \sPaces
1820 :LL26
1830    JSR #F7FD \for each
1840    DEX        \"indent
1850    BNE LL26   \ level".
1860 \
1870 \ Print till end of statement.
1880 :LL27
1890    DEY
1900 :LL28
1910    INY
1920    LDA (T),Y \get next char
1930    STA #83    \save it
1940    JSR #FFE9 \& Print it.
1950    CMP @#3B   \end of statement?
1960    BEQ LL29   \carry set if so.
1970    CMP @#D    \end of line?
1980    BNE LL28   \continue if not.
1990    CLC        \else clear carry
2000 :LL29
2010    RTS              \and exit.
2020 \
2030 \  tables
2040 :TT0 \logical mask values;]
2050 !P=#02040204; P=P+4
2060 [:TT1 \reserved words,1st char;]
2070 $P="DFUN";P=P+LENP
2080 [:TT2 \offsets to rest of words;]
2090 P?0=-1; REM "O"
2100 P?1=53; REM "OR"
2110 P?2=16; REM "NTIL"
2120 P?3=21; REM "EXT"
2130 P=P+4
2140 NEXT
2150 P.$6;@=1
2160 P." *SAVE""FORMLIST"""&H," "&P'
2170 P."TO RUN:-"'
2180 P."L=(0 TO 15); LINK #"&H'
2190 @=8
2200 END
```

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ATOMIC SPACE TEST

A 'bytes free' routine by Barry Pickles

THIS utility for the Atom provides a 'bytes free' routine, as found on machines such as the Pet and Vic. It uses 94 bytes of machine code and assembles at #28A0, thus avoiding corruption by floating point arrays. Once assembled, it may be called at any time by LINK #28A0.

By using the 'free space' pointer, it allows for any array storage. Unlike some other routines, it does not rely on your knowing where your memory storage ends; instead, it tests for RAM at all 1k boundaries in the text space, until the test fails. The test used is a modification of the one which the Atom itself makes to find out if you have any lower text space RAM.

The listing is fully commented, so only the system routines need explaining. These are:

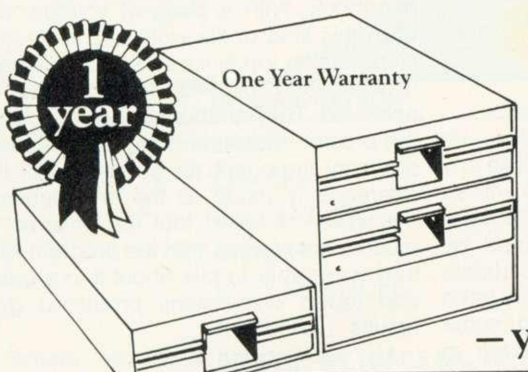
- #FFED – performs a carriage return and linefeed.
- #FE71 – treats the following characters as an ASCII string and outputs to the screen, until a negative byte (NOP) is encountered.
- #C589 – takes the (32-bit) number on the workspace stack and prints it in decimal form.

To assemble to a different area, alter the value of P in line 10.

```
  1 REM Bytes Free Routine
  2 REM by B.Pickles
  3 REM Acorn User February 1983
 10 DIM LL2; PRINT$21; FORN=0 TO 1; P=#28A0
 15 [
 20 LDA@0          : Initialise
 30 STA#80         : Set up 81H
 40 STA#81         : and 82H as
 50 STA#321        : vector to
 55 TAX            : text space
 60 LDA@#2C        : and set @=0
 70 STA#82         :
 80 CLC            :
 90 :LL0           :
 95 LDA@#55        : Check RAM at
100 JSR LL1        : start of each
110 BNE LL2        : 1k block.
120 ASLA           : If test passed,
130 JSR LL1        : increment vector
140 BNE LL2        : and continue
150 LDA#82         : until test fails
160 ADC @4         : or all text RAM
170 STA#82         : area has been
180 CMP@#80        : tested, then
190 BEQ LL2        : go to LL2
195 JMP LL0        :
200 :LL1           :
210 STA(#81,X)     : RAM test
220 CMP (#81,X)    : subroutine.
230 RTS            :
240 :LL2           :
245 JSR#FFED       : Output CR/LF
250 SEC            :
255 LDA#81         : Subtract address
260 STA#34         : in 'free space'
265 STA#43         : pointer (23H and 24H)
270 SBC#23         : from vectors
275 STA#16         : in 82H and 81H
280 LDA#82         : Store result on
290 SBC#24         : workspace stack
300 STA#25         : at 16H and 25H
310 JSR#C589       : Output w/s stack
320 JSR#FE71       : Print following string
330 ]
340 $P=" BYTES FREE"
345 P=P + LEN(P); REM-Increment pointer
350 [
360 NOP            :
370 LDA @ 8        : set @=8
380 STA#321        : and
390 RTS            : exit
400 ]
410 NEXT
420 PRINT$6; END
```

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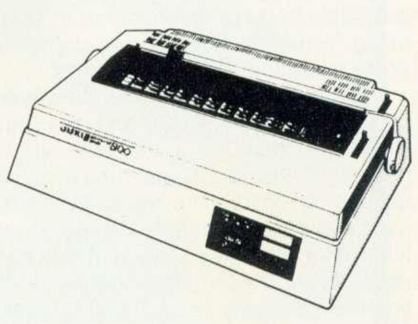
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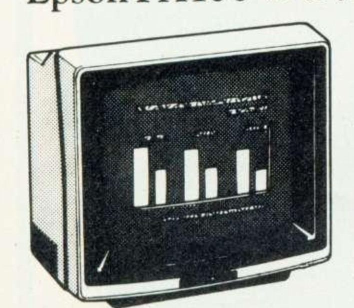
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FAIRWEATHER FRIEND

Martin Hill tests the Factfile suite in the classroom. His pupils' project was to record meteorological conditions

WHEN Kenley Primary School acquired its BBC microcomputer I was keen to use it for activities which involved as many of the pupils as possible and which fitted naturally into the school's curriculum. I had seen Factfile demonstrated on an in-service course and it seemed to meet these requirements, although I had some reservations about using cassettes to store large amounts of data and I was not sure how well the children would cope with the new language which Factfile demanded.

Factfile is provided as part of the MEP Microprimer pack (and can be purchased separately from Cambridge University Press). The package contains three pieces of software and an extremely useful teacher's handbook.

The first program, Yourfacts, is meant as an introduction to using a database program without the need to previously define the file structure. It was helpful to a class of 9 to 11-year-olds, but they found it rather easy and the data somewhat predictable. A top infant class found it most enjoyable, but reception infants needed a great deal of teacher supervision and were unable to understand most of the words.

Because the questions asked in Yourfacts demanded a positive reply from nearly every child in the class, the follow-up work became rather pointless. The program can, however, be a useful preparation for Factfile if more emphasis is placed on the techniques for updating files.

When the children progressed on to Factfile one of the most important skills they needed to learn was how to change a file. Mistakes were often made when keying in data and it was rather demanding on teacher-time to have to remind groups about making a change. It is therefore advisable to dwell on changing a file when using Yourfacts so that the children become accustomed to the process.

A class of first-year juniors were doing a project about dinosaurs and the datafile Dino was ideal as a teaching aid. The names of the dinosaurs, however, were difficult for children to remember and the use of this file tended to complicate matters rather than help when learning how to use Factfile. The teaching materials did not emphasise clearly enough that Dino was a file and not a program and so could be used only after loading Factfile.

We began our project by studying the geographical aspects of the weather after watching the excellent BBC TV programme *Near and Far*. Before long we found ourselves inundated with scrap paper on which were scrawled recordings of the rainfall (photo 1), wind speed (photo 2), and humidity and temperature (photo 3) for each day in January. Many pupils felt that we needed to find a better method of storing and analysing information – so why not use our computer and a datafile?

The children were already familiar with the computer because it is treated like any other resource at Kenley (photo 4) and so the idea of Factfile was quite easy for them to accept. Nevertheless, we started by using the introductory program Yourfacts, which was just as well. Mistakes were often made when keying in data and some children found it helpful to go back to Yourfacts and practise changing a file.

The children worked in groups of three or four and used a computer when they had collected the weather data for one week. Other groups awaiting their turn were meanwhile compiling information grids ready for feeding their data into the computer (see table, page 139).

When choosing the project that Factfile would assist, I decided not to have 'yes/no' answers as suggested in the teacher's handbook. With a class of younger children this kind of file would be quite sufficient, but for top juniors it limits the amount of interesting follow-up work that can be achieved. The handbook states clearly that the project chosen and the follow-up work are very important for success, but little reference is made to the importance of discussion. I found that the children felt much more at ease with the program when they were able to talk about it in a group, and taped discussions produced good results.

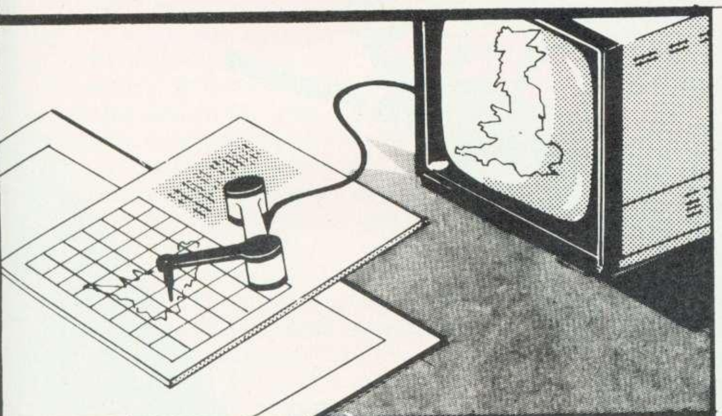
My decision not to choose 'yes/no' responses to be keyed into the computer created its own problems. The children had to be very careful when adding data to



Photo 1. Measuring rainfall

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Photo 2. Measuring windspeed with improvised equipment

the file as the computer would differentiate between different spellings of the same word, additional punctuation and spaces between words. For example 'cold, * sunny' is different to 'cold *, sunny'.

It was also difficult to decide whether to include the units in the table. If they are left out, there's less typing and less chance of error, but questions are less satisfactory. For example TEMP – 10 is not as informative as TEMP – 10C. Again, by getting the children to talk about the program this problem was alleviated considerably.

Some groups had problems when trying to save a file. Data was lost for no apparent reason, even though the children recorded their files quite correctly. There was really no way of checking to see if the file had been saved successfully without leaving the program and thus losing the possibility of recording the current datafile. In many cases the file had not been recorded properly, resulting in a frustating loss of time.

When saving a file it proved inadvisable to record over a used tape as old data often spoiled the new file. This was true when saving a datafile but not when recording an ordinary program. The handbook is quite correct in stating that 'one file – one tape' is a sound rule. The BBC cassette system is indeed inadequate and our school is looking forward to acquiring discs.

Photo 3. Measuring maximum and minimum temperatures and humidity at the school's weather station

Mistakes were often made by children who were too quick on the button. They had to be told not to return to the Choice Page in the middle of typing in data if they make a mistake. Several groups wasted valuable computer time by pressing the escape key when they made the smallest mistake. The children also had to be told to think before they pressed return and to confirm the data with the computer.

The problems with saving the data and the tedium of asking many questions in Factfile may explain why some children, unless watched, quite happily completed the follow-up work from the original information collected for the computer rather than from data saved in their file.

Others preferred to look at every item on the file rather than take the option of asking a direct question. Once shown the correct procedure the children were ready to accept the tremendous power that a computer has and went directly to the answers. It was important, however, that each child should understand how to manipulate a



datafile and so computer whizzkids, too quick on the button, were outlawed.

I found the program was best used as an extension of class work because the children associate the fun they have with the computer with other subjects, including the dreaded maths, and thoroughly enjoy all aspects of a project. I believe children should have experience of using a computer before tackling Factfile as they need to familiarise themselves with a keyboard and confront some of the problems that occur.

These activities were all carried out as part of my normal teaching of full classes and so I was not always available to help groups that had problems, especially when saving, making, and loading a file. I therefore trained as computer monitor boys and girls who liked using the computer and were willing to help others. There was no shortage of volunteers and my young deputies were able to save everyone a great deal of time.

The children produced some excellent work for their folders and enjoyed the whole project, not just using the computer. Used as an extension of class work Factfile works very well, but one wonders whether the project has done much for the art of conversation. People already talk about little else but the weather. ●

Martin Hill teaches at Kenley Primary School, Croydon.

POINTS TO REMEMBER

1. The BBC cassette system is inadequate and careful tape management is essential.
2. Information retrieval packages use artificial languages which are difficult for young pupils.
3. Many pupils will prefer to process their data manually, unless the database has a large number of records and a language that is simple to use.
4. Well-designed data collection sheets help to speed the input of data.
5. Field values should be kept as simple as possible to reduce the chances of mis-typing.



Photo 4. The computer is treated like any other resource at Kenley

File name: WEATHERJAN

Day	*Min temp*	*Max temp*	*Humidity*	*Rainfall*	*Anemometer*	*Wind speed*	*Cloud type*	*Description of the weather*
1	10C	11C	5%	0	9	Gentle breeze	Cumulus	Cold, sunny
2	5C	8C	29%	0	11	Moderate breeze	Cumulus	Cold, sunny
3	−4C	6C	20%	0	13	Moderate breeze	None	Cold, sunny
4	−2C	3C	35%	0	1	Light air	None	Cold, misty
5	−1C	4C	76%	0	14	Moderate breeze	Stratus	Cold, dull
6	0C	6C	77%	5	18	Moderate breeze	Stratus	Cold, wet
7	3C	10C	100%	5	0	Calm	Stratus	Misty, dull
8	4C	9C	100%	5	10	Light breeze	Nimbus	Cold, dull
9	−3C	3C	89%	0	50	Strong breeze	Stratus	Snowing
10	8C	9C	68%	0	6	Light breeze	Cumulus	Cold, sunny

Information grid for weather project station

KEY SKILLS

Elizabeth Segall spells out a routine to help juniors find their way around the keyboard

CHILDREN may have none of an adult's inhibitions about approaching a computer and establishing 'eye-to-eye' contact, but they have a greater need for keyboard familiarisation and practice.

This introductory program for primary schoolchildren provides keyboard experience in a constructive manner. It has been used successfully by many children in the 7-11 age group, and has proved popular with both the children and their teachers.

Apart from being asked to find random letters, the child learns to find numbers, to spell his or her teacher's name and to provide an answer to a standard 'menu' type of question. The program needs no documentation as it is self-explanatory and the child is led from question to question.

As it stands, the program, called Intro, caters for a four-form entry school with 14 teachers (see figure 1), but can easily be adapted for more or fewer staff names. For example, if there are only three teachers in year 1, replace MRS ONE-4 in line 1060 by BLANK; on the other hand, if year 2 has four members of staff, replace BLANK after MRS TWO-3 by teacher TWO-4's name (also in line 1060).

With a little programming knowledge further questions could be added to give the program more local or individual characteristics.

KEY 0 is defined as a RUN key and this can be used after the first time through. ●

NA% / YR%	1	2	3	4
1	MR ONE-1	MRS ONE-2	MISS ONE-3	MRS ONE-4
2	MISS TWO-1	MR TWO-2	MRS TWO-3	BLANK
3	MRS THREE-1	MISS THREE-2	MR THREE-3	BLANK
4	MR FOUR-1	MRS FOUR-2	MISS FOUR-3	MR FOUR-4

Figure 1. Existing staff names on line 1060 of Intro program

```
    1  REM *** INTRODUCTORY PROGRAM ***
    2  REM ***        FOR          ***
    3  REM   *** PRIMARY SCHOOLS  ***
    4  REM   *** c. T.& E.SEGALL  ***
    5  REM **    version 2 : Oct.83    **
   10  MODE 7
   20  *KEY0 RUNIM
   30  *KEY 10 OLDIM RUNIM
   40  *FX11,0
   50  ON ERROR GOTO1030
   60  X=RND(-TIME)
   70  PROCHEAD
   80  A=INKEY(350)
   90  DIM TE$(4,4),TRANS$(5)
  100  CLS
  110  PRINT''''"AFTER YOU HAVE ANSWERED A QUESTION, YOU"
  120  PRINT'SPC(4);"NEED TO PRESS THE  RETURN  KEY"
  130  PRINT'''TAB(18)CHR$133 "BUT":PRINT'''TAB(3);"if you want to leave the pr
ogram":PRINT'TAB(8);"press the ESCAPE key."
  135  REM ***     NAME QUESTION     ***
  140  PROCCONT
  150  PRINTTAB(17,7);"HELLO"
  160  PRINT''"LET'S BEGIN BY INTRODUCING OURSELVES"
  170  PRINT TAB(0,13)CHR$131:INPUT TAB(1,13)"WHAT IS YOUR NAME ?  "NA1$
  180  N1=INSTR(NA1$," "):N2=INSTR(NA1$,"-"):N3=INSTR(NA1$,"_")
  190  IF N1=0 AND N2=0 AND N3=0 THEN NA2$=NA1$ ELSE PRINT'''CHR$134;"ONLY ONE N
AME, PLEASE":PROCCONT:GOTO 160
  200  Pos%=0:Len%=LEN(NA2$)
  210  IF Len%>12 GOTO270
  220  REPEAT
  230    Pos%=Pos%+1:Asc%=ASC(MID$(NA2$,Pos%,1))
  240    IF Asc%<65 OR Asc%>90 GOTO 270
  250    UNTIL Pos%=Len%
  260  GOTO 290
  270  CLS:PRINTTAB(12,5)CHR$131;"I can't believe":PRINT''TAB(8)CHR$131;"that yo
ur name is really":PRINT'''TAB(INT((38-Len%)/2))CHR$130;CHR$141;NA2$:PRINTTAB(IN
T((38-Len%)/2))CHR$130;CHR$141;NA2$
  280  PROCCONT:GOTO 160
  290  IF NA2$="TONY" THEN PRINT''"THAT'S FUNNY, SO IS MINE." ELSE PRINT''"GOOD.
```

```
MY NAME IS TONY."
  295  REM ***    DATE QUESTION    ***
  300  PROCCONT
  310  PRINT''CHR$131" THE FIRST THING I WOULD LIKE TO KNOW":PRINTCHR$131" IS TO
DAY'S DATE."
  320  PRINT'"PLEASE FILL IN THE MISSING NUMBERS"
  330  INPUT ''"YEAR......19"P1:IF P1<>84 THEN PROCERR:GOTO 300
  340  PRINTTAB(0,12);CHR$131"(Use 1 for Jan.,2 for Feb.,3 for Mar.,":PRINTCHR$1
31" 4 for Apr. ...)"
  350  INPUT TAB(0,10)"MONTH....."P2$:P2=VAL(P2$)
  360  PROCCHECK(P2$,12,P2)
  370  IF E=1 THEN PROCERR:GOTO 300
  380  PRINTTAB(0,17);CHR$131"(Enter the number,5 or 26,for example)"
  390  INPUT TAB(0,15)"DAY......."P3$:P3=VAL(P3$)
  400  PROCCHECK(P3$,31,P3)
  410  IF E=1 THEN PROCERR:GOTO 300
  420  IF P2=2 AND P3>29 THEN PROCERR:GOTO300
  430  IF P3>30 AND (P2=4 OR P2=6 OR P2=9 OR P2=11)THEN PROCERR:GOTO 300
  440  PRINT''''CHR$129"GOOD"
  450  FOR YR%=1 TO 4
  460    FOR NA%=1 TO 4
  470      READ TE$(YR%,NA%)
  480      NEXT NA%:NEXT YR%
  485  REM ***   CLASS QUESTION    ***
  490  PROCCONT
  500  PRINT ''CHR$131"TELL ME,  ";NA2$",":PRINTCHR$131"WHAT YEAR ARE YOU IN ?":P
RINT''"(FIRST,SECOND,THIRD OR FOURTH ?)"
  510  INPUT''""AN$
  520  IF LEN(AN$)<5 THEN PROCERR:GOTO 490
  530  IF AN$="FIRST" THEN PROCYR(1):GOTO580
  540  IF AN$="SECOND" THEN PROCYR(2):GOTO580
  550  IF AN$="THIRD" THEN PROCYR(3):GOTO580
  560  IF AN$="FOURTH" THEN PROCYR(4):GOTO580
  570  PROCERR:GOTO 490
  575  REM *** JOURNEY QUESTION   ***
  580  PROCCONT
  590  RESTORE 1070
  600  PRINT''"THE NEXT THING I WOULD LIKE TO KNOW IS  HOW YOU GET TO SCHOOL EAC
H MORNING."
  610  PRINT'CHR$131"DO YOU....."
  620  FOR I=1 TO 4
  630    READ TRANS$(I)
  640    PRINT'CHR$131 I;SPC(4);CHR$135;"COME BY ";TRANS$(I)
  650    NEXT
  660  PRINT'CHR$131;SPC(9);"5";SPC(4);CHR$135 "WALK"
  670  PRINTTAB(0,19)CHR$131:INPUT TAB(2,19) "1,2,3,4,OR 5 ?    " T:IF T<1 OR T>5
 THEN PROCERR:GOTO 580
  680  PROCCONT
  690  IF T=5 PRINT''CHR$131;TAB(6);"ABOUT HOW LONG DOES YOUR ",'CHR$131;SPC(6)"
WALK TAKE ?" ELSE PRINT''CHR$131;TAB(6)"ABOUT HOW LONG DOES YOUR   ",'CHR$131;SPC
(6)TRANS$(T);" JOURNEY TAKE ?"
  700  PRINTTAB(8,9);"MINUTES"
  710  INPUT TAB(5,9)""TI1
  720  IF TI1<1 THEN PROCERR:GOTO680
  730  LET TI2=TI1*190
  740  PRINT'''TAB(15)"YOU  SPEND"
  750  PRINT'"ABOUT";CHR$133;TI2 DIV 60;CHR$135;"HOURS &";CHR$133;TI2 MOD 60;CHR
$135;" MINUTES TRAVELLING"
  760  PRINT'"TO SCHOOL EACH YEAR AND ABOUT THE SAME"
  770  PRINT'"LENGTH OF TIME GOING HOME."
  775  REM *** D.OF B. QUESTION   ***
  780  PROCCONT
  790  PRINT''CHR$131"FINALLY ";NA2$;", I WOULD LIKE"
  800  PRINT CHR$131"TO KNOW YOUR DATE OF BIRTH"
  810  INPUT '''"YEAR......19"B1:IF B1<10 OR B1>79 THEN PROCERR:GOTO 780
```

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► from page 141

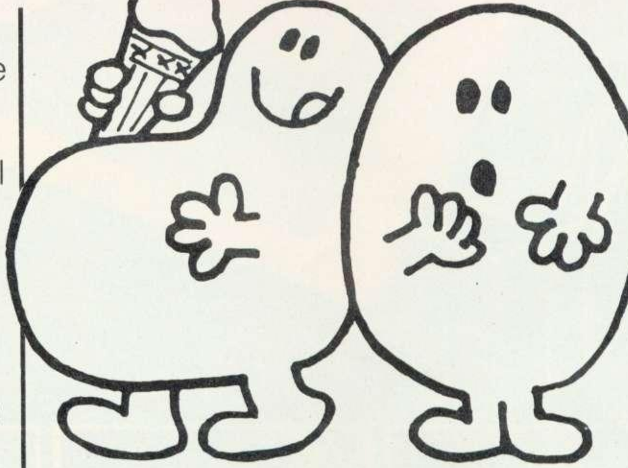
```
820  PRINTTAB(0,12);CHR$131"(Use 1 for Jan.,2 for Feb.,3 for Mar.,":PRINTCHR$1
31" 4 for Apr. ...)"
830  INPUT TAB(0,10)"MONTH....."B2$:B2=VAL(B2$)
840  PROCCHECK(B2$,12,B2)
850  IF E=1 THEN PROCERR:GOTO 780
860  PRINTTAB(0,17);CHR$131"(Enter the number,5 or 26,for example)"
870  INPUT TAB(0,15)"DAY......."B3$:B3=VAL(B3$)
880  PROCCHECK(B3$,31,B3)
890  IF E=1 THEN PROCERR:GOTO 780
900  IF INT(B1/4)<>B1/4 AND B2=2 AND B3=29 PRINTTAB(6,19);CHR$134"19";B1;" WAS
 NOT A LEAP YEAR":GOTO 780
910  IF B2=2 AND B3>29 THEN PROCERR:GOTO780
920  IF B3=31 AND (B2=4 OR B2=6 OR B2=9 OR B2=11)THEN PROCERR:GOTO 780
930  PROCCONT
940  IF P3>=B3 THEN A3=P3-B3 ELSE PROCAGE:B2=B2+1
950  IF P2>=B2 THEN A2=P2-B2 ELSE A2=P2-B2+12:B1=B1+1
960  A1=P1-B1
970  PRINT'''"I HAVE WORKED OUT THAT YOUR AGE TODAY IS"
980  PRINT'''CHR$129;SPC(8);A1;CHR$135;" YEAR";:IF A1<>1 PRINT"S" ELSE PRINT "
"
990  PRINT''CHR$129;SPC(8);A2;CHR$135;" MONTH";:IF A2<>1 PRINT"S" ELSE PRINT "
"
1000  PRINT''CHR$129;SPC(8);A3;CHR$135;" DAY";:IF A3<>1 PRINT"S" ELSE PRINT " "
1010  IF A1>16 PRINT'''TAB(6);CHR$134;CHR$136;"STILL";CHR$135;"AT SCHOOL.......
?"
1020  PROCCONT
1030  *FX12,0
1040  CLS: PRINTTAB(10,8);CHR$134;CHR$141;"T H E    E N D":PRINTTAB(10,9);CHR$
134;CHR$141;"T H E    E N D"
1050  PRINT'''''CHR$131;SPC(5);"To start the program again ":PRINT'CHR$131;SPC
(1)"press the"CHR$129;"red f0"CHR$131;"key on the top line"
1060  DATA MR.ONE-1,MRS.ONE-2,MISS ONE-3,MRS.ONE-4,MISS TWO-1,MR.TWO-2,MRS.TWO-
3,BLANK,MRS.THREE-1,MISS THREE-2,MR.THREE-3,BLANK,MR.FOUR-1,MRS.FOUR-2,MISS FOUR
-3,MR.FOUR-4
1070  DATA BUS,CAR,BIKE,TRAIN
1080  END
2000  DEF PROCHEAD
2010  NAME1$="PLEASED  TO  MEET":NAME2$="Y O U"
2020  PRINT''CHR$151;CHR$188;STRING$(37,CHR$172);CHR$180
2030  FORI=3 TO 8
2040    PRINTTAB(0,I);CHR$151;CHR$181;TAB(39,I);CHR$181
2050    NEXT
2060  N1=INT((38-LEN(NAME1$))/2):N2=INT((38-LEN(NAME2$))/2)
2070  PRINTTAB(0,9);CHR$151;CHR$181;TAB(N1);CHR$129;NAME1$;CHR$151;TAB(39);CHR$
181
2080  PRINTTAB(0,10);CHR$151;CHR$181;TAB(39);CHR$181:PRINTTAB(0,11);CHR$181;TAB
(N2);CHR$131;NAME2$;CHR$151;TAB(39);CHR$181
2090  FORI=10 TO 18
2100    PRINTTAB(0,I);CHR$151;CHR$181;TAB(39,I);CHR$181
2110    NEXT
2120 PRINTTAB(0,19);CHR$151;CHR$181;TAB(5);CHR$183;STRING$(29,CHR$163);TAB(35);
CHR$181;TAB(39);CHR$181
2130  PRINTTAB(0,20);CHR$151;CHR$173;STRING$(3,CHR$172);CHR$181;CHR$131;CHR$157
;CHR$129;"An introductory program ";CHR$156;CHR$151;CHR$189;STRING$(3,CHR$172);C
HR$165
2140  PRINTTAB(4,21);CHR$151;CHR$245;STRING$(29,CHR$240);CHR$181
2150  ENDPROC
3000 DEF PROCCONT
3010 C1=RND(90):IF C1<65 GOTO3010
3020 PRINTTAB(5,23);"PRESS LETTER ";CHR$130;CHR$(C1);CHR$135;" TO CONTINUE"
3030 REPEAT :C2=GET: UNTIL C2=C1
3040 CLS
3050 ENDPROC
```

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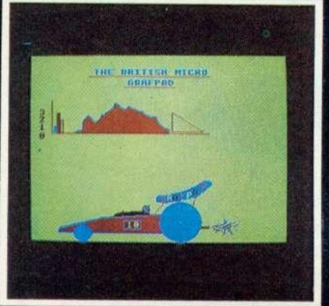
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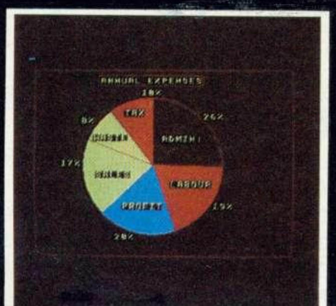
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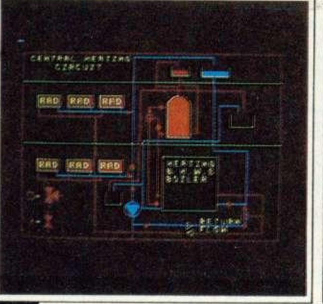
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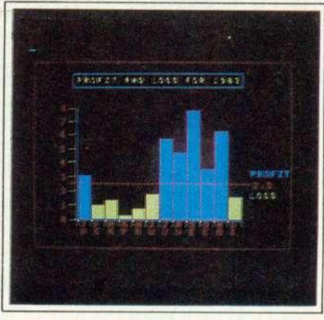
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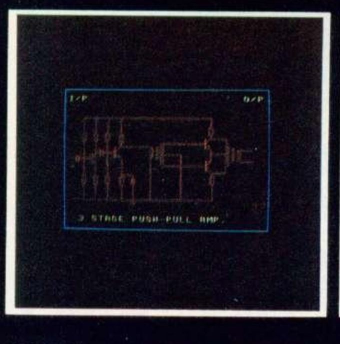
(Size: 25mm height x 55mm width x 260mm depth)
Weight: 1.2 kg (Gross)

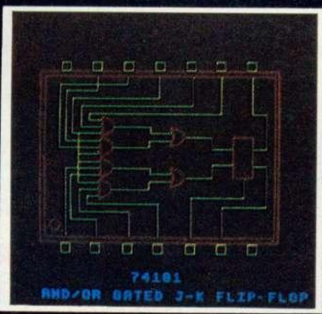












(The above designs were drawn by a 12-year-old at our showrooms!)

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```
 4000 DEF PROCERR
 4010 PRINTTAB(2,21);CHR$133"I THINK YOU HAVE MADE A MISTAKE"
 4020 ENDPROC
 5000 DEFPROCCHECK(D$,M,D)
 5010  E=0:P=0:L=LEN(D$)
 5020 REPEAT
 5030    P=P+1:A=ASC(MID$(D$,P,1))
 5040   IF A<48 OR A>57 THEN E=1
 5050   UNTIL P=L
 5060 IF D>M OR D<1 THEN E=1
 5070 ENDPROC
 6000 DEF PROCYR(X%)
 6010 PRINT''CHR$131"WHO IS YOUR TEACHER ?"
 6020 PRINT''TE$(X%,1);"   OR   ";TE$(X%,2);"   OR   ":PRINT'TE$(X%,3);:IF TE$(X
%,4)="BLANK" PRINT" ?" ELSE PRINT"   OR   ";TE$(X%,4);" ?"
 6030 INPUT '""TE1$
 6040 IF TE1$=TE$(X%,1) OR TE1$=TE$(X%,2) OR TE1$=TE$(X%,3) OR TE1$=TE$(X%,4) PR
INT'CHR$134"YOU'RE VERY LUCKY" ELSE CLS:PRINT'''CHR$133"WHO ?":GOTO6020
 6050 ENDPROC
 7000 DEF PROCAGE
 7010 ON B2 GOTO 7020,7040,7020,7030,7020,7030,7020,7020,7030,7020,7030,7020
 7020 A3=P3-B3+31:GOTO 7050
 7030 A3=P3-B3+30:GOTO 7050
 7040 IF 4*INT(B1/4)=B1 THEN A3=P3-B3+29 ELSE A3=P3-B3+28
 7050 ENDPROC
```

► **from page 45**

tory screens of games are often mode 7 graphics, and an example of an Acornsoft and a Virgin screen are shown in figures 6 and 7. If you have access to a teletext adaptor then the teletext screen from Ceefax or Oracle can be dumped. I am very fond of the weather pictures, though there seems to be a problem with the picture-save mechanism corrupting the top left-corner of the screen. This may be caused by the pictures having been saved via Econet.

There are three possible approaches to getting a dump from the programs:

1. *SAVE the picture to tape or disc. This is accomplished simply for Acornsoft programs as the picture is saved in machine code hidden just above TOP.

To get at it

LOAD the initial program
PRINT TOP (this gives a 4 digit hexadecimal number tttt)
*SAVE "picture_name"tttt +400

The teletext adaptor SAVE produces a file which is of this type.

You should now LOAD the screen dump program and insert the lines

```
1 MODE7
2 *LOAD"< picture_name>"7C00
```

and run the resulting program.

2. Find the place in the drawing program where the screen is in the state you want, and insert the lines

```
PAGE=&3000
CHAIN"<dumper-name>"
```

3. RENUMBER the dump so that its line numbers start at a number higher than the last line of the drawing program. Merge the dump on to the drawing program (*User Guide*, page 402), inserting at its *start*

```
DEFPROCdump
```

and replacing its END by

```
ENDPROC
```

Now insert the lines

```
PROCdump
END
```

into the drawing program where you want the dump to occur, and RUN.

You may be troubled by Searching and Loading messages if you use tape. To remove them (but also their warnings of trouble!) insert VDU21 before any load operation, and follow it with VDU6.

Finally a challenge. Many printers have only the conventional dot-matrix facility. I have ideas of how to obtain the graphics characters via a normal matrix band of dots, but have no time to develop them. If any reader has done this, please write in. Send us your program, and samples of its output for us to evaluate, and possibly pass on through the letters column to other readers. Adaptations of the method outlined, for other printers, would also be of interest. ●

► *from page 45*

```
 610 VDU2
 620 VDU1,27,1,ASC":",1,0,1,0,1,0
 630 VDU1,27,1,ASC"6"
 640 VDU1,27,1,ASC"%",1,1,1,0
 650 VDU1,27,1,ASC"&",1,0,1,128,1,170
 660 REPEAT
 670 DUMMY=BGET#CH
 680 FOR I%=1 TO 12
 690 VDU1,BGET#CH
 700 NEXT
 710 UNTIL EOF#CH
 720 CLOSE#CH
 730 VDU3
 740 ENDPROC
 750
 760 DEFPROCptext
 770 IF scan%=1 THEN VDU1,32:ENDPROC
 780 IF char=163 THEN char=96
 790 IF char=223 THEN char=35
 800 IF char=224 THEN char=95
 810 char=char AND &7F
 820 IF (char>90 AND char<97) OR char>122 THEN
PROCspecials ELSE VDU1,char
 830 ENDPROC
 840
 850 DEFPROCspecials
 860 I=-2
 870 REPEAT
 880 I=I+2
 890 UNTILspecial?I=char
 900 VDU1,special?(I+1)
 910 ENDPROC
 920
 930 DEFPROCpgraphics
 940 IF scan%=0 THEN PROCgraphics1 ELSE
PROCgraphics2
 950 ENDPROC
 960
 970 DEFPROCgraphics1
 980 IF char=35 OR char=223 THEN VDU1,35:
ENDPROC
 990 PROCswapem
1000 IF index=4 OR index=5 THEN PROCptext
ELSE VDU1,base+(char MOD 16)
1010 ENDPROC
1020
1030 DEFPROCgraphics2
1040 PROCswapem
1050 IF index=2 OR index=4 OR index=5
THEN VDU1,32:ENDPROC
1060 IF index=3 THEN VDU1,base+4
1070 IF index=6 THEN VDU1,base+8
1080 IF index=7 THEN VDU1,base+12
1090 ENDPROC
1100
1110 DEFPROCswapem
1120 IF char=96 THEN char=35
1130 IF char=95 THEN char=96
1140 char=char AND &7F
1150 index=char DIV 16
1160 ENDPROC
```

Program 3. Teletext dump for the Epson FX80 with all extra characters defined using 'download characters'

```
   10REM FILE CREATOR
   20ON ERROR CLOSE#CH:REPORT:PRINT" at line
";ERL:END
   30CH=OPENOUT("C.TTCHARS")
   40FOR I=1 TO 559
   50READ code
   60BPUT#CH,code
   70NEXT
   80CLOSE#CH
   90END
  100REM DATA for codes
  110DATA 128,133,0,0,0,0,0,0,0,0,0,0,0
  120DATA 129,134,224,0,224,0,224,0,0,0,0,0,0
  130DATA 130,140,0,0,0,0,0,0,224,0,224,0,224
  140DATA 131,140,224,0,224,0,224,0,224,0,224
,0,224
  150DATA 132,134,28,0,28,0,28,0,0,0,0,0,0
  160DATA 133,134,252,0,252,0,252,0,0,0,0,0,0
  170DATA 134,140,28,0,28,0,28,0,224,0,224,0,
224
  180DATA 135,140,252,0,252,0,252,0,224,0,224
,0,224
  190DATA 136,140,0,0,0,0,0,0,28,0,28,0,28
  200DATA 137,140,224,0,224,0,224,0,28,0,28,0
,28
  210DATA 138,140,0,0,0,0,0,0,252,0,252,0,252
  220DATA 139,140,224,0,224,0,224,0,252,0,252
,0,252
  230DATA 140,140,28,0,28,0,28,0,28,0,28,0,28
  240DATA 141,140,252,0,252,0,252,0,28,0,28,0
,28
  250DATA 142,140,28,0,28,0,28,0,252,0,252,0,
252
  260DATA 143,140,252,0,252,0,252,0,252,0,252
,0,252
  270DATA 144,133,0,0,0,0,0,0,0,0,0,0,0
  280DATA 145,133,0,96,0,96,0,0,0,0,0,0,0
  290DATA 146,139,0,0,0,0,0,0,0,96,0,96,0
  300DATA 147,139,0,96,0,96,0,0,0,96,0,96,0
  310DATA 148,133,0,12,0,12,0,0,0,0,0,0,0
  320DATA 149,133,0,108,0,108,0,0,0,0,0,0,0
  330DATA 150,139,0,12,0,12,0,0,0,96,0,96,0
  340DATA 151,139,0,108,0,108,0,0,0,96,0,96,0
  350DATA 152,139,0,0,0,0,0,0,0,12,0,12,0
  360DATA 153,139,0,96,0,96,0,0,0,12,0,12,0
  370DATA 154,139,0,0,0,0,0,0,0,108,0,108,0
  380DATA 155,139,0,96,0,96,0,0,0,108,0,108,0
  390DATA 156,139,0,12,0,12,0,0,0,12,0,12,0
  400DATA 157,139,0,108,0,108,0,0,0,12,0,12,0
  410DATA 158,139,0,12,0,12,0,0,0,108,0,108,0
  420DATA 159,139,0,108,0,109,0,0,0,108,0,108
,0
  430DATA 160,139,0,16,40,84,0,16,0,16,0,16,0
  440DATA 161,140,0,0,240,0,0,0,18,36,2,40,18
  450DATA 162,139,0,32,0,32,0,32,0,168,80,32,
0
  460DATA 163,138,16,0,32,0,126,0,32,0,16,0,0
  470DATA 164,140,0,0,240,0,0,0,4,8,20,0,62
  480DATA 165,136,0,0,126,0,0,0,126,0,0,0,0
  490DATA 166,140,144,8,160,72,144,0,4,8,20,0
,126
  500DATA 167,139,0,16,0,16,0,84,0,16,0,16,0
  510DATA 168,139,0,16,0,16,0,16,0,16,0,16,0
  520DATA 169,138,18,0,126,128,18,128,18,128,
66,0,0
  530DATA 170,140,0,0,254,0,254,0,254,0,254,0
,254
```

Program 4. File creator

THE AMCOM ALTERNATIVE

Bruce Smith files his verdict on the Beeb DFS from Pace

ONE OF the major investments any Beeb owner will make after the initial outlay for the computer is for a disc drive and disc filing system. Several of the major makes of the former have already been scrutinised in these pages, so now its the turn of the software. Until the middle of last year only one disc filing system (DFS) was available (if you could get it!), that being the one produced by Acorn. Recently, however, two more have appeared on the market, produced by Pace and Watford Electronics, embodying major innovations over the 'standard' version. I've had the Amcom DFS under the hammer for the last couple of months so let's see what it has to offer.

The Pace package arrives complete with 8k EPROM, manual, utility disc, eight-way DIL switch and DFS registration card. Fitting the DFS is straightforward, though a major omission from the package is fitting instructions. The experienced sideways ROM fitter will have no problems but for the novice guidance will be needed. The EPROM was fitted with no difficulty next to the Basic chip. On switching on, the message

Amcom DFS S/N A7686

was displayed, indicating everything was OK. Typing *HELP DFS had no effect other than to display the current OS number. A quick delve into the useful manual revealed that *HELP pages are present but these are actually resident on the utilities disc. So I thrust this into the drive and executed SHIFT-BREAK, which ran a series of introductory pages describing the major areas of the DFS. Further information on the use of the DFS commands was available from disc using *HELP #DFS.

Probably the most endearing feature of the Amcom DFS is that it supports two different modes of operation. System 0 is the Acorn mode and System 1 the extended mode. Either may be selected by the commands *SYS 0 or *SYS 1.

As all software being produced by software houses on disc is manufactured for use with the standard DFS, the implementation of the Acorn mode is imperative for compatibility. In this mode the Amcom DFS acts similarly to Acorn's DFS, using a maximum of seven characters per filename with up to 31 files per disc. The Amcom DFS has an advantage though, as it uses less RAM for workspace, the default value of PAGE being &1500 as opposed to Acorn's &1900.

In the extended mode filenames of up to 15 characters may be used with up to 63 files per disc. These extra files are created by reserving eight sectors at the start of the disc for catalogue information instead of the two sectors required in Acorn mode. This is a particularly nice feature, as huge amounts of space can be wasted on discs when storing numerous small files.

For the technically minded reader table 1 details the mode differences. To distinguish extended mode from the Acorn mode of operation the first bit of the first sector of the disc is set; on executing SHIFT-BREAK the DFS checks this bit and automatically selects that mode as the operative one. One consequence of using this method to select modes is that if any proprietary software on disc has a coloured title the system will try to boot up in extended mode, as this bit is used to indicate to the OS that a coloured print is required. This can be overcome by using utility present on the utilities disc, appropriately called 'Acorniser', which puts the house in order by clearing the set bit.

What happens when you try to read an Acorn disc while in extended mode? A 'Bad System' message is issued.

Before a new disc can be used it must be formatted. *FORMAT is a command present in the DFS which carries this out in the currently selected mode. Before doing this the number of sectors and tracks can be selected using two new *OPT commands. *OPT2,n selects the number of sectors per track with n=10 being the default value for a standard 5¼ inch disc. *OPT3,n selects the number of tracks per disc, so *OPT3,40 would select 40 tracks on the current disc. My first attempt at formatting produced a 'Not enabled' message.

Back to the manual. Before any commands that can cause a disc to be overwritten are performed a further command, *ENABLE, must be used. This ensures that no cataclysmic outrages occur if a format command is used inadvertently and acts as a safeguard. Nice one!

Once the format command is entered the DFS checks to see if the disc contains any files. If it does then the prompt 'Erase Y/N?' is issued. Formatting will take place only if Y is returned in response to the prompt. As formatting progressed the track number is displayed, followed by a G to indicate a good track. If a bad track is encountered a B is printed and the DFS

Acorn Mode

Sector	*Bytes*	*Details*
00	00-07	Initial eight letters of disc title
	08-0E	Filename of the first file
	0F	Directory name for first file
	10-17	Filename of second file
	18	Directory name for second file
	18-1E	etc.
01	00-03	Last four bytes of disc title
	04	Cycle number
	05	Number of files on disc * 8
	06	Bits 0,1 – two high-order bits of number of sectors Bits 4,5 – !BOOT start-up options
	07	Low-order bits (0-7) of number of sectors on disc
	08-0E	Data for first file
	10-17	Data for second file
	18-1F	etc.

Extended Mode

Sector	*Bytes*	*Details*
00	00-03	Last four bytes of disc title
	04-05	Reserved (?)
	06	Bits 0,1 – bits 8,9 of number of sectors on disc Bits 4,5 – !BOOT start-up options
	07	Bits 0-7 of number of sectors on disc
	08-0F	First eight bytes of disc title
	10-1F	Reserved
	20-3F	File specification for first file
	40-5F	File specification for second file (File specifications continue in 32-byte blocks)
07	E0-FF	File specification of 63rd file.

Table 1. The differences between the Acorn mode and extended mode of operation in the Amcom DFS

tries to format it once again. Thus the disc is formatted and verified at the same time.

Saving and loading programs whether they be Basic or machine code can be carried out in the usual manner. The implementation of these differs slightly from the Acorn DFS. For example, with the Acorn DFS executing LOAD"LYDIA" would load a file called 'LYDIA' or 'lydia' – in other words it does not differentiate between upper and lower case filenames; the Amcom DFS does, so 'LYDIA' and 'lydia' would be implemented as two different files. I find the latter much more helpful, particularly in the Acorn mode, where only seven characters are allowed in filenames. With the Amcom DFS it is possible to have 'LYDIA' chain 'lydia'.

On power-up the disc directory is set as '$'. Other directories may be selected using the *DIR command, which should be followed by the desired directory. Thus to set the current directory to 'D' the command *DIR D must be executed. To save a file to any directory it must have its directory and filename specified in the save command delimited by a full stop. Thus to save the file 'UTIL' in directory X the syntax is:

SAVE "X.UTIL"

similarly to reload the file

LOAD "X.UTIL"

is used. Once again a distinction is made between upper case and lower case letters so that the directory 'X' is distinct from the directory 'x'.

Files can be protected from being overwritten by locking them. With the Amcom DFS this process can be performed as the file is saved. The lock is induced by preceding the directory with the tilde symbol thus:

SAVE "~X.UTIL"

If you have dual drives you'll need to switch between them. *DRIVE n allows this, where n is the drive number. The default value is drive 0. Drives may be specified in load and save procedures by pre-fixing them with a colon. Therefore a program can be saved to drive 1 using:

SAVE ":1.X.UTIL"

Similarly, programs can be reloaded from specified drives.

Machine code (the object kind) can be *SAVEd and *LOADed in similar vein. The *RUN command can be abbreviated to a single asterisk so that *CODE would load and run a machine code program called CODE. As with Basic, the drive and directory can be specified in the run parameters. For example, the object code generated by Program 1 and saved in directory M can be *RUN using

*:0.M.CODE

with the :0 indicating the disc is present in drive 0.

At times files need to be unlocked so that they can be deleted or updated. This process is somewhat long-winded using the Amcom DFS, though it goes some way to ensuring that you don't unlock the wrong file. The command to use is, surprisingly, *RENAME. Usually this will be used to enable you to change the name of a file from, say, 'USER' to 'ABUSER' in which case you would use:

*RENAME "USER" "ABUSER"

To unlock the file the file's name, including the title, is specified first followed by a new name. A locked file must be given a new name, otherwise a 'File already there' message is issued. To unlock 'X.UTIL':

*RENAME "~X.UTIL" "X.UTI"

could be used.

Being familiar with the Acorn DFS, I inadvertently tried to lock a file using the *ACCESS command provided for that purpose in Acorn's DFS but not, according to the manual, present in current issues of the Amcom DFS. Surprise, surprise! – it worked, to an extent. What happened was that when I entered:

*ACCESS "PROG" L

in the normal manner the file's name was displayed, followed again by its 'L for locked' designation. The process of printing this name was then repeated, and repeated. . . I hit the panic button (Acorn calls it ESCAPE!) to restore the status quo. To my surprise, entering *CAT revealed that the program had indeed been locked! After that I wasn't so surprised to find that entering

*ACCESS "PROG"

in the normal manner unlocked the file, though it was necessary to escape from the ensuing loop. Subsequent peeking around in the depths of the Amcom DFS revealed the *ACCESS coding. As I said, this is not a legal call, so if you use this DFS you shouldn't use *ACCESS as it may have other side-effects.

The *CAT and *INFO commands allow the current disc to be catalogued and program information extracted. Table 2 shows typical outputs from these commands. The *CAT command is implemented slightly differently from that on the Acorn DFS in that it does not present an alphabetical list of files. The files that constitute the current directory are printed in two columns, followed by the files in other directories down the righthand side of the screen. This makes reading the catalogue somewhat more difficult especially if you have a lot of files in different directories, although placing the Beeb in paged mode overcomes this. The *INFO command provides detailed information on the file or files specified. Both commands operate noticeably slower than their Acorn counterparts.

Wildcards are available to allow a de-

*BACKUP <src drv> <dest drv>	Makes exact copy of one disc to another
*BUILD <fsp>	Builds a text file from keyboard
*CAT <drv>	Displays the catalogue of the disc
*CLEAR <drv>	Erases contents of whole disc
*COMPACT <drv>	Moves all files to one end of disc
*COPY <scr drv> <dest drv> <afsp>	Copies specified file to another disc
*DELETE <afsp>	Deletes specified file from disc
*DIR <dir>	Sets current directory to one specified
*DRIVE <drv>	Selects current drive
*DUMP <fsp>	Produces hex & ASCII dump of file
*ENABLE	Allows use of 'dangerous' commands
*EXEC <fsp>	Reads in a text file
*FORMAT <drv>	Formats a disc
*INFO <afsp>	Prints catalogue information of files
*LIB :<drv>.<dir>	Selects the current library
*LIST <fsp>	Gives a numbered listing of a text file
*LOAD <fsp> xxxx	Loads in file to specified location
*OPT 1,n	Changes display format of file specification
*OPT 2,n	Selects number of sectors per track
*OPT 3,n	Selects number of tracks per disc
*OPT 4,n	Selects auto-boot option
*OPT 5,n	Sets start of DFS buffer
*OPT 6,n	Controls file specification display
*OPT 7,n	Selects length of DFS buffer
*OPT 8,n	Enables 80-track drive to read 40-track software
*RENAME <old fsp> <new fsp>	Renames or unlocks a file
*RUN <fsp>	Loads and runs a machine code program
*SAVE <fsp> ssss fff eee	Saves a specified section of memory
*SPOOL	Copies all information printed on screen to disc
*SYS <system>	Select Acorn or extended mode
*TITLE <title>	Write disc title
*TYPE <fsp>	Type out text file on screen
*WIPE <asfp>	Deletes selected files corresponding to ambiguous file specification

Table 2. Commands available under the Amcom DFS

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gree of ambiguity in naming files. The characters allowed are '#' and '*'. The hash can be used to represent a single character, so that *INFO"T#P" would display the intimate details of files such as TAP, TOP, TIP etc, if present in the current directory. The asterisk can represent any number of characters so that the file 'LONGNAME' can be loaded using LOAD "L*", provided there are no other files in the current directory beginning with L.

Two commands are implemented to enable discs or files to be copied once they have been *ENABLED; these are *BACKUP and *COPY respectively.

An excellent feature of the Amcom DFS is that it is possible to define where in memory a disc buffer can be created to be used by *COMPACT, *COPY and *BACKUP as they go about their tasks. This means any programs or data in memory need not be currupted by these commands. For example, if a program is resident in memory from &1500 up to &3320 the disc buffer could be defined as starting at &3400 with an *OPT 5,52 command, where 52=&34 in decimal. Executing a *COMPACT command will ensure that the DFS uses only memory above &3400 for its workspace. Using an *OPT 7,n command, it is possible to define how long the disc buffer is. The value specified in n refers to the number of 256 byte blocks, therefore a disc buffer 1k long can be set using *OPT7,4. A further *OPT command is provided to allow some 80-track disc drives to read 40 track software. The manual stresses the 'some' but does not indicate which.

*OPT 6 allows you detailed control over the display of file specification The value given to n must be a decimal number, the binary value of which is used at bit level to determine whether a certain part of a file's specification is to be displayed or not. For example, bit 1 relates to the directory display. If it is set then the directory will be displayed; if clear it will not. So if you wanted to display the files directory when a disc is accessed the command *OPT 6,3 should be executed. The 3 is derived from the fact that bit 1 has a decimal weight of 2 plus 1 to enable display. Similarly, to display directory, drive and load address when the disc it accessed bits 1, 2 and 5 must be set. A carriage return can be performed if bit 7 is set, so adding these bit weights we obtain:

Directory	=	2
Drive	=	4
Load address	=	32
Carriage	=	128
Display on	=	1
TOTAL	=	167

Executing *OPT 6,167 and accessing the disc with a *LOAD command produces:

```
*LOAD "X.FILE"
X FILE 0 1500
```

*CLEAR is another new command which must first be *ENABLEd before use as it clears a whole disc of its contents. The drive may be specified, otherwise the current drive is used as default.

One thing that became apparent when using the Amcom DFS was that it seemed to operate slower than its Acorn rival. I set about writing a series of benchtest programs. My first effort was program 2. Running this produced the following output:

```
TIME TAKEN = 0.15
```

This was obviously wrong but several more re-runs produced the same result. I began to question my programming ability but quickly swapping back to the Acorn DFS and re-entering the program produced:

```
TIME TAKEN = 3.0
```

Replacing the Amcom DFS, I located a machine code program I had written some time ago that uses the interval timer to update a digital clock displayed at the top of the screen. With the clock happily ticking away I re-ran the program. As the disc was being accessed the clock stopped! Further playing around with the interval timer showed that whenever a read or write to the disc was made the internal clock was not updated. This would be a serious drawback for anyone wishing to use their micro to control external equipment and needing the event timer to create an interrupt at requisite times to initiate polling routines or the like. It also meant that my set of benchtests which relied on the time function had gone out of the window.

Off to the workshop and a few chips, bits of ribbon cable and my faithful old Atom later (Barry, are you reading this?) I return. The idea was that I connect the Atom to the Beeb with some software on both sides that would enable a signal from the Beeb to start a machine code clock ticking away on the Atom. A further signal would then stop the clock displaying the elapsed time accurate to 1/60th of a second. It actually worked! The start and stop signals were initiated by about 30 bytes of machine code stored from &C00, with CALL &C00 sending a 'start' signal and CALL &C20 the 'stop' signal.

Table 3 shows the results I obtained, comparing the timings of the Amcom with the Acorn 'official' DFS. Overall there is not

Program	Description	Acorn 0.9	Amcom A7686
	Save 1K program	1.5	2.5
	Load 1K program	1.2	1.3
DFS1	*SAVE 4k memory	3.0	3.6
DFS2	*LOAD 4K memory	3.3	3.0
DFS3	*SAVE 8K memory	3.8	4.8
DFS4	*LOAD 8K memory	4.0	4.2
DFS5	BPUT 1024 bytes	5.5	5.9
DFS6	BGET 1024 bytes	4.5	3.4
DFS7	Move PTR 512 bytes	1.6	2.2
DFS8	Write 1000 strings	21.0	16.3
DFS9	Read 1000 strings	19.5	8.8
DFS10	Random access output	55.5	63.5
DFS11	Random access input	43	23.2

Table 3. Comparison of timings (in seconds) for the Acorn and Amcom systems

```
LIST
   10 REM *** M/C DEMO ***
   20 P%=&C00
   30 [
   40 \ clear screen sound bell
   50 LDA #12 : JSR &FFE3
   60 LDA #7  : JSR &FFE3
   70 RTS
   80 ]
   90 REM save on drive 0
  100 REM in directory M
  110 *SAVE":0.M.CODE" C00 +12
```

Program 1.

```
>LIST
   10 REM ** DFS TIMING **
   20 TIME=0
   30 *SAVE "TEST" 2000 +2000
   40 A%=TIME
   50 PRINT "TIME TAKEN = ";
   60 PRINT A%/100
```

Program 2.

a great deal to choose between them. The results show that while the Acorn DFS saves more quickly the Amcom DFS loads quicker, except with the last four tests in which the system under review has a noticeable edge – which would make it a good choice if you expect to handle large data files.

Besides making the time function unusable the DFS has two other side effects. I often start typing my next instruction into the Beeb before it has finished executing the current one, knowing that the keyboard interrupt routines will take my message and store it into the keyboard buffer to await processing. Because of the way the Amcom system works this typing ahead is not possible.

I came across the other side-effect when running an old program. If sound statements of short duration are used followed by a DFS command, the duration of the sound is increased severalfold. For example, running

```
10 SOUND 1,-15,1,1
20 *CAT
```

would cause a SOUND equal to a duration of about five to be output!

The manual supplied with the DFS is a very good 68-page affair, the first 13 pages of which give an overview of the system followed by a page-by-page description of each of the DFS commands, in most instances giving programming examples. Random access files, technical information and the DFS from Assembler are also fully covered.

The utilities disc is divided into three sections. Section A contains the six *HELP pages of information on the DFS and its commands. Section B provides screen dumps for the Epson and NEC printers. Not having either I was unable to try them out. However, the instruction sheet states that they may be called as an OS command from within programs, assuming the utilities disc is available. Thus a mode 0 screen dump could be produced on an Epson using *EPSON0.

Section C is the most interesting as it contains five useful programs. As I said, the first 'Acorniser' eradicates a coloured title from a disc, allowing it to work correctly in Acorn mode. Program 2 is a utility which allows the user access directly to disc sectors, allowing them to be read individually to memory, edited and restored.

The Amcom DFS is certainly compatible with all the disc-based software I could throw at it and in most instances it performed as well as its Acorn counterpart, if not better. Certainly from the point of view of handling random access files it excelled. I have also been using Disc Doctor (see last month's review and Joe's Jottings in this issue) in conjunction with the DFS and again no problems were encountered.

The Amcom DFS has several extra extremely usful commands which have been well thought out in their implementation. The ability to define a disc buffer is a great advantage.

The effect that the DFS has on the interval timer must be considered a serious drawback – after all, the BBC Micro is an excellent machine that we wish to add to, not take away from.

In summary if you have an Acorn DFS I would not consider the extra facilities offered by the Amcom DFS sufficient for you to contemplate changing. Likewise, Amcom DFS owners would not gain any benefit from changing to the Acorn version.

Educational and scientific establishments would probably find the Amcom DFS not suitable to their needs in view of its ineffective time function, critical for timing and polling experiments. But the home user thinking of upgrading from tape to disc would find the extra features offered by the Amcom DFS worth considering. ●

Amcom DFS, from Pace Software Supplies, 92 New Cross Street, Bradford BD5 8BS (tel: 0274 729306), £34 inc VAT (complete upgrade kit £95 inc VAT)

LISP

► page 89

```
((EQ op '+) (PLUS arg1 arg2))
((EQ op '-) (DIFFERENCE arg1 arg2))
((EQ op '*) (TIMES arg1 arg2))
((EQ op '/) (QUOTIENT arg1 arg2))
(T (PRINTC 'Unknown BLANK
   'operator BLANK op))))
```

T is used to trap unknown operators.

Returning to myevaluator, if expression is just a number we return that number as result. We can now set up myevaluator for use as a general-purpose calculator with a simple recursive function.

```
(DEFUN calculator ()
  (PRINTC (myevaluator (READ)))
  (calculator))
```

READ reads in a complete Lisp expression (ie, a number, textual item or list) from the keyboard. In the next article I will introduce LOOP, which enables you to do this non-recursively, but for the time being this is a perfectly satisfactory definition. To run the calculator we enter:

```
(calculator)
```

and then type in expressions.

The functions defined can be saved for future use by the SAVE function:

```
(SAVE 'FRED)
```

saves all the defined functions in a standard state in a file called FRED. This file is known as an image. To restore all the functions on a future occasion use:

```
(LOAD 'FRED)
```

This will destroy *any functions defined at the time LOAD is used*. Use it only at the start of a session, or after using SAVE. I will give details of how to merge two images in the next article.

This is somewhat crude. Apart from trapping unknown operators it won't detect errors. In the third article I will look at a Lisp function for easing error handling. For the time being we could add checks that lists do genuinely have three items, and that if something is not a list it is a number (it could be text).

'We use LISTP to test whether an expression is a list'

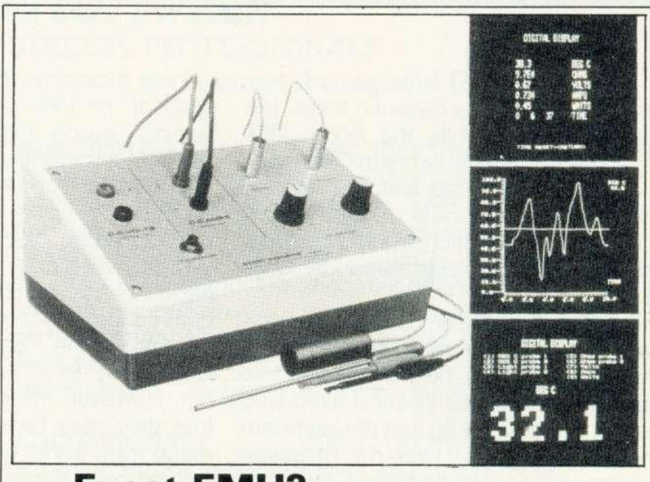
We could extend the program to include a conditional operator of the form:

(? arg_1 (THEN arg_2 ELSE arg_3))

which would require altering myevaluator to return something appropriate if it gets handed a THEN list (perhaps return it unchanged) and altering evaluate-operator to be able to handle the ? operator (if arg_1 is 0 then use whatever follows the THEN, otherwise use whatever follows the ELSE). You can add extensions to your heart's content, building up a more and more complex Lisp-like language. A good example in real life is the REDUCE algebraic manipulation language of Tony Hearn, which is widely used in mathematical research both in this country and the USA.

In the next article I'll look at the internal structure of Lisp and more complex ways of handling data, and discuss the use of the Lisp editor and super-printer, and strategies for developing and debugging Lisp programs. This will give the necessary tools for demonstrating an arbitrary precision arithmetic package, manipulating arbitrarily large numbers, and performing calculations with them.

In the concluding article I'll look in detail at function definition and show the mathematical theories underlying Lisp, investigate the uses of the language in artificial intelligence, and other areas of research, and consider new languages that have developed from Lisp. Finally I'll present a simple computer-aided design system written in Lisp. ●


DIGITAL DISPLAY
32.1

BEEBPEN PROVIDES A CLEAR, UNCLUTTERED WORKSPACE



Figure 1. Ringbinder and EPROM

```
                         A (append mode)
        I (insert mode)                          O (overwrite mode)
p (printing mode)                                       S (set margins)

                          COMMAND MODE

f (find)                                                 W (write a file)
      L (load a file)                            B (block operations)
                         D (delete line)
```

Figure 2. There are five modes, all accessed through Command mode

Beebpen EPROM, from Braintech, 81 Rydal Crescent, Perivale, Middlesex UB6 8DZ, £42.55, BBC (32k OS 1.0 or later).

AFTER the initial purchase of a BBC micro, one of the first important applications of the new 'toy' is word processing. Combined with a good printer and a suitable software package, the Beeb can begin to get down to some work. Once mastered, the power and flexibility of a word processor leaves the typewriter well and truly for dead. In this review I hope to be able to highlight the attributes and shortcomings of a recently released word processor, Beebpen.

Unlike other WPs of its type, Beebpen comes packaged in a ringbinder. This contains the documentation, registration card and the EPROM containing the program (see figure 1). Detailed instructions are given as to the fitting of the chip and with a little care nothing should go wrong. In the unlikely event of a problem being encountered, Braintech can be relied upon for assistance.

Once the lid is back on, typing *BE. displays the question: "WARM START? Y/N". Responding with 'Y' preserves any text in memory; 'N' clears the memory for new text. Immediately you enter the command mode from which all the facilities of Beebpen are accessed. Beebpen uses five modes: Append, Command, Insert, Overwrite and Printing.

It is through the command mode that all other modes and sub-menus are accessed (see figure 2). Return to the command mode from any other mode is achieved by typing 'CTRL z'.

Perhaps the most noticeable characteristic of Beebpen is that all editing and formatting commands are one-key entries. The function keys are not used at all. There are two kinds of commands: those that have an effect, then return you to the command mode; and those that cause a change in the manner in which Beebpen responds to key presses. That is, those which put you permanently into another mode, for example.

The display is an 80-column screen mode (there is no other option). This enables on-screen formatting similar to View. The screen acts as a 'window', scrolling up and down over the text. At the top of the window is a permanent area which displays information relating to the page format, margin settings, TAB stops and line length. The current mode of operation is displayed in the inverse colour (see figure 3 overleaf).

What is rather a surprise at first is the text colour, which is green, not the conventional white. This gives a rather pleasing effect on a colour monitor and is very clear indeed on a monochrome monitor. The ruler at the top of the screen has a mark at each of the tab stops; initially TAB is set at every eighth column, but this can be changed. The bottom ruler is always set to every eighth column. Line lengths can be adjusted to any value between 1 and 254 columns. TAB has a range of 1 to 254 and page length 10 to 255 lines.

The bottom portion of the screen is reserved for the messages or sub-menus that the system uses to keep you informed of what is going on. Here, information such as file names and error messages is displayed (see figure 3).

The cursor keys have been reprogrammed to allow movement between beginning and end of lines, and paging is achieved by the combined use of the Copy key and cursor keys. All the block operations are there, allowing movement, copying and deletion of text. Typing 'B' gives entry to a sub-menu that permits you to 'M', 'C' or 'D' a block of text. The system uses the '\' character (beside the ← cursor key), to mark the text to be moved.

All drastic and irreversible commands such as 'kill to end of text' are trapped and you are asked politely: 'SURE (Y/N)?' before any further action is taken. Any key other than 'Y' aborts the operation. 'Search and replace' is quite flexible, allowing for the use of 'wildcards'. Both global and selective searches are possible. However, upper and lower case are recognised separately.

Formatting does not take place automatically as text is entered. Instead, using the single key entries 'F' (format), 'M' (margins) and 'C' (compress) you can format single paragraphs or large blocks of text. The 'M' command enables reformatting to both left and right margins. 'C' is used before attempting any formatting to enable the system to get rid of any 'soft' spaces that it has inserted.

Printer control is taken care of by the insertion of printer control codes directly into the text. This allows a variety of printers to be used with Beebpen without modification. The embedded commands appear in inversed colour. When formatting or printing Beebpen ignores all embedded commands. Typing 'P' (for printing) will enable selection from a number of options, each of which defaults to sensible values. The options are:

1. Page length
2. Page width
3. Centring
4. Page numbering
5. Page heading
6. Paging
7. Number of copies
8. From cursor?

File saving and loading is quite straightforward; all DFS and operating system commands are available through the command mode. A pleasing feature of the 'W' command (write text to disc) is the check that Beebpen makes to see if you are saving a file with a name that already exists. If you are it will ask: 'File exists, OVERWRITE? (Y/N)'. Press any key other than 'Y' and Beebpen asks you to re-enter the file name. DFS errors are not trapped and when Beebpen encounters one it is most likely to restart (a warm start).

Beebpen aims at the serious user by providing an 80-column screen from which to work. If you propose to use Beebpen regularly for long periods then a green-screen monitor would be vital – a television is really out of the question. The screen layout is very good indeed, providing a clear basis with which to write. The various single key (or CTRL [key]) commands take a bit of getting used to, especially if you have been working with other word processors which use function keys. This would be of no consequence to anyone beginning word processing with Beebpen. Personally, I find jumping from mode to mode

a little wearing, but it depends on what you're used to.

Beebpen performs all editing and formatting well and the 'help' menus are of great assistance. Setting and resetting the tabs and page/margin parameters is simplicity itself, enabling rapid changes in formatting. In this respect Beebpen is a compromise between the screen rulers of View and Wordwise's simple approach.

When entering text at a slow typing speed Beebpen pauses fractionally to refresh the screen. I found this a little odd at first but again it's a matter of familiarity. A touch typist would never notice. All block operations functioned as expected, the 'wild' facility being particularly valuable.

The A5 ringbinder contained 40 pages of instructions. A good index is provided covering all the major topics but I would like to see more detail in later versions. Finding out how to perform a specific function is a little difficult, but a comprehensive reference section is provided at the back. The manual contains two tutorials of different complexities to get you started. These are indeed helpful. The value of the ringbinder approach is that future updates of the manual can be inserted without disturbing the other sections. It is a thoughtful and well-written manual.

Braintech has adopted a policy of continuous improvement (explained in the back of the manual). Your version can be returned with the registration card and for a small handling fee the latest version will be dispatched. This means owners of all versions are able to benefit from later improvements and additions.

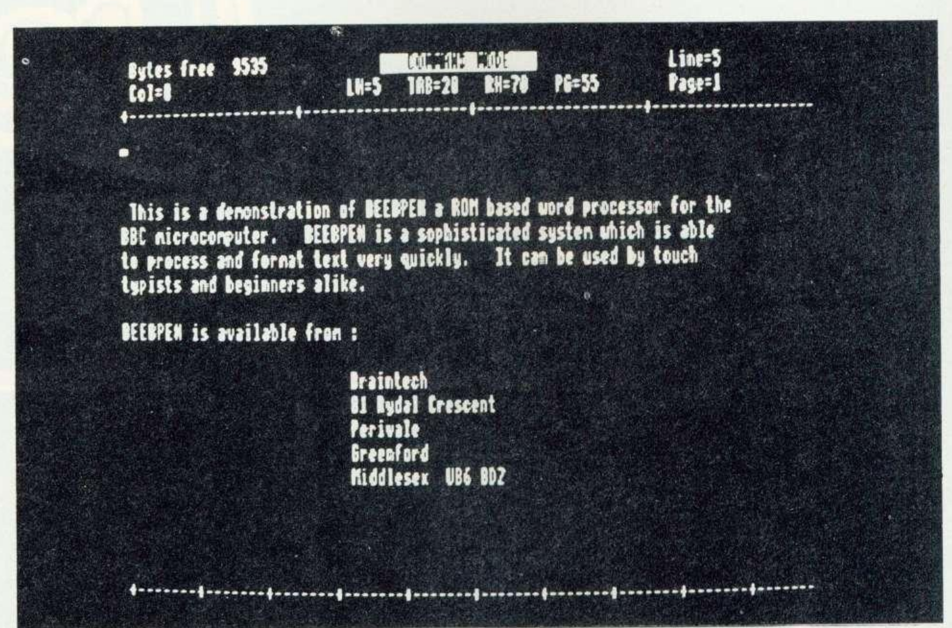


Figure 3. The current mode of operation is displayed in inverse colour

Perhaps the major shortcoming of this flexible little WP is its inability to use continuous processing on large files. As the memory fills, pages must be saved and a long document must be printed out in sub-sections. Macros of a sort can be created by putting text in the function keys, but the comprehensive macros created by View are not available in Beebpen.

The features which I like are: the clear, uncluttered workspace; on-screen formatting; visible tabs and margin setting; wild card search and replace; programmable function keys; support of multiple printer functions; user-friendly system; and the ease of upgrading when necessary.

Beebpen is suitable for beginners yet has enough facilities to be of value to the experienced user. **Chris Drage**

EXPAND YOUR ATOM BIT BY BIT

The Clare System, from Clare Computer Components, 46 Bath Road, Stroud, Glos GL5 3JL (tel: 04536 78904). See panel for prices

Prices (inc VAT)	
Master module	£57.50
Secondary module	£57.50
16k ROM module	£31.63
Programmer	£40.25
25v PSU	£8.05
Battery unit	£6.90

THE Clare System is an expansion system for the Atom, capable of extending memory by 128k, up to 64k of which may be in RAM. Expansion is done by a series of modules, each one physically connected to the next. Up to eight modules may be stacked and the concept is similar to that of the 'Organic Micro' series for the ZX81. The system is connected to the Atom's 64-way expansion bus and is controlled by the lower three bits of port B, so you need the VIA and bus buffers fitted before you start.

Four types of module are available, each one housed in a similar cream-coloured plastic case, giving a neat appearance overall. Each case has two 64-way connectors, a plug at the front and a socket at the rear. The Acorn bus is not completely carried through, the main difference being that port A is removed so that those pins can carry the control lines for the other modules. Port A is still available at the Atom's printer port and writing to it will not affect operation of the system.

Each module can be purchased separately, but you must begin with the 'master' module. This contains 8k of CMOS RAM and sockets for two 2532/2716 type EPROMs. It also contains the necessary logic to control all the other modules. These comprise a secondary 8k RAM/ 8k ROM module, a 16k ROM module (4 × 2716 and 2 × 2532) and an EPROM progrmamer. As noted, up to seven of these modules may be stacked onto the master but, since this would put a fair strain on the Atom's connector, the designers recommend that a jumper cable (which Clare will supply) be used if you are stacking more than two. A master module may be run (just!) from a normally expanded Atom, but after this you will need a secondary supply. Clare says that an extra 1A will suffice and the company can supply a unit, or you can build one yourself. This does not replace the Atom's own supply, it simply adds more power to it.

With this in mind, each module contains a mini-jack socket so that extra power may easily be added at any point – a nice touch that! Additionally, in the master and secondary RAM/ROM modules, there is another socket for a battery back-up unit to the CMOS devices. Finally, the EPROM programmer needs a 25v supply and – yes – a socket is provided.

With any part of the system you get a complete manual, giving details of the bus pinouts and of how to use the system (including a small Basic program). How easy is it to use?

Connection is simple and the units are sturdy enough to withstand my ham-fistedness. When installed, the extra memory is mapped from &4000 to &7FFF, the CMOS RAM occupying the first two blocks and the remaining two being assigned to EPROMs. The mapping is the same for all the units (except the programmer) and this proved to be both a blessing and a drawback.

Because of the mapping, it is easy, by manipulating the bits on port B, to call any program, RAM or ROM, in any of the modules – indeed, programs in one module may call routines in another. This gives you enormous scope to write exceedingly complex programs. The trouble is that, because EPROMs map from &6000 onwards, you cannot use any commercially available ROM inside the system, unless you are prepared to readdress it and re-blow it, so you can't use the system as a

'pager' for things like Wordpack or Atomcalc.

The designer's idea is that you develop your own programs (in CMOS RAM), then blow these into EPROM for the system. This is not a task to be undertaken lightly and I can't help thinking that there are going to be a lot of empty EPROM sockets. Clare hopes to be able to provide its own ROM library, but that remains to be seen and I feel more emphasis should be placed on the RAM expansion. Having said that, it does work and would be an ideal way to develop a dedicated controller.

The final component is the EPROM programmer. This is an unusual device, in that it contains its own PIA (rather than using the Atom's 6522) and so could be adapted for other machines. It contains its own program, an EPROM mapped to &9800, and will program and verify for any address in the Atom's memory map. The front of the unit holds a ZIF socket and switches for read/write and PROM selection. Use is simple – just follow the prompts.

This is a lovely system and its design has been well thought out, with the exception, perhaps, of the ROM mapping. Any serious programmer will have no difficulty in making full use of its facilities. It is nicely styled and fairly rugged.

As can be seen, it does not come cheap! The price, says Clare, reflects the fact that these units are not manufactured in their thousands, owing to the nature of the market. This is fair comment, but may lead to a 'Catch 22' situation. Nonetheless, the EPROM programmer is good value and a system comprising master module and programmer would be welcome in many a programmer's den.

Finally, I should point out that this Clare has no connection with the firm of similar name supplying BBC add-ons and software. **Barry Pickles**

COMMOTION UNDER THE OCEAN

Sea Wolf by Mark Smiddy, Optima Software, BBC B, £8.95

AT FIRST glance this looks like just another Star Trek derivative, but hidden inside is an absorbing game.

You're in the Sea Wolf, a nuclear submarine, sent to sink 15 enemy ships. You select your skill level: rating, ensign, gunner, captain or commander and off you go. On the left of the screen is a chess-board grid showing the position of all the enemy boats; to the right a view through the periscope – with cross-wire sights for aiming the laser or torpedoes. In the bottom half of the screen are all kinds of data: energy and oxygen, number of 'kills', morale of crew, etc. Everything except the speed you're travelling (selected by keys 0-9 and indicated by 'engine tone').

The display is in boring white and black – until condition yellow or red show you're in trouble. Your projectiles are coloured too, and when a target's about to sink it turns psychedelic first. The sound effects are realistic too.

So you venture away from base. The cursor keys move you provisionally around the grid and when you're happy with the position, and the amount of energy it'll take to get there, you press f4 to 'warp'. And so into combat. The display tells you what kind of ship is hanging around in this zone: tanker, destroyer, carrier, cruiser, battleship, and so on and if the enemy is to the right or left. You move the sights using A and Z for up and down, and < and > for left and right. Select lasers (f0) or the weaker torps (f2) and fire using spacebar. A few shots and the ship's destroyed. It can get you though – and if you're moving too fast you can ram the ship and end the game. You don't have to destroy the enemy ship to leave the zone, and you can return to base at any time to replenish supplies (though this is considered wimpish by fleet command).

Periodically the positions of the enemy ships change (according to predefined rules, says the instruction booklet). Good tactics are rewarded with promotion; poor tactics may result in demotion. The game is played in real time, against the clock.

A couple of disappointments: on the periscope display all the ships, whether carriers or frigates, look exactly the same. And the size of the target ship remains the same however close you are. Worst of all, the game blurts out its congratulations even if you play atrociously! **Alan Pipes**

BLOOD CLOT

Microbe by Simon Birrell, Virgin Games, BBC B, £7.95

CAN humans play Simon Birrell games? If you thought *Bug Bomb* was fast *Microbe* is manic. The story goes that you've been blasted into an all-powerful alien's bloodstream to eliminate its biological defences – antibodies, aminos, ribosomes, red cells and spores – from the inside. Biology 'O' level is no advantage.

You pack a gun in each of your crab-like claws and can not only move back and forth along the bottom of the screen, space-invader fashion, but can go up and meet the nasties head on. It's a cross between *Galaxians* and *Centipede*, but there are no hiding places. Really it's a very slick and professionally designed game. The sound and visual effects are exemplary – but oh it's fast! **Alan Pipes**

ASSEMBLY LANGUAGE WITHOUT THE JARGON

BBC Micro Assembly Language by Bruce Smith, from Shiva Publishing (tel: 0270 628272), £7.95

THIS book is one of Shiva's friendly micro series. It fills the considerable need for a simple introduction to 6502 assembly language on the BBC micro.

Books on assembly language programming tend to assume that the reader has totally mastered Basic, structured programming, computer jargon, and is in fact a bit of an expert. Bruce Smith's book, *BBC Micro Assembly Language,* does not fall into this trap. Obviously you are assumed to know some Basic, or you would not have the need for the assembly language, but he avoids jargon and does not make the mistake of trying to air his cleverness by printing lots of very erudite and incomprehensible programs as illustrations. In fact, the longest program in the book – sensibly towards the end – is 85 lines. This is tiny by assembler standards.

This does not mean that there are no programs in the book. It is packed with clear, pithy examples which illustrate the ideas which beginners find so confusing.

The layout is clear, the chapters are short, and each is devoted to a single topic. It is inevitable that the concept of binary numbers has to come first, but skip chapter three if you can. The strings of 0's and 1's are not really that difficult, nor is it essential for the following chapters that you understand binary or BCD in detail.

There are inevitable weaknesses. The most fundamental problem is in the addresses that the author recommends for the storing of his assembly language. Really &D00 and &1500 will not do, even for beginners. I would recommend the perusal of the excellent summary by Ian Birnbaum in the January 1984 issue of *Acorn User* and the relocation of the programs by one of the quite simple means outlined there. There is a brief (and clearly rushed and incomplete) attempt to catch up with Basic 2, which would have been better omitted.

A useful appendix gives methods of executing Basic commands in assembly language and there's a one-page resumé of the way the 6502 executes instructions. There are the inevitable instruction set and ASCII code table.

There is a tape to go with the book, but I doubt its necessity. It is probably better to type the programs in.

This book is an excellent beginner's guide and will lead to a better understanding of some of the more erudite articles in this and other magazines. It will also whet the appetite for something more advanced. **George Hill**

SECRETS OF THE DUNGEON

Simon Dally separates the trolls from the dwarves with the solution to his triple competition

THE competitions featuring dwarves and trolls which began in our September issue last year enabled many of you to ramble for three months in the *Acorn User* dungeon – a period of time which seemed too short for some of you!

This was probably the most popular of all our competitions to date – entries came in by the sackload and I never cease to be amazed at the devious logical roads taken by some of your twisted minds.

It is inevitable, I suppose, that if one writes about dwarves and trolls a few of the little fellows will infiltrate the printing works to add further confusion to already troubled waters: more about the misprints later. Meanwhile, here is a complete list of the answers to the puzzles and logical problems.

September issue

1.) £44,444 4s 4d
2.) 419
3.) 51*246, 24*651, 75*231, 65*281, 86*251, 42*678, 87*435, 57*834, 78*624, 65*983, 72*936 (sum of products=379164).
4.) 102564

Room 1: A is a dwarf, B is a troll
Room 2: A is a troll, B is a dwarf, C is a troll
Room 3: C is definitely a troll
Room 4: A is a troll, B a dwarf
Room 5: C is the magician
Room 6: A is the magician (you can't tell whether he's dwarf or troll)
Room 7: A is a dwarf magician

So much for the answers. The main problem with this puzzle was that, having told you that you always carried forward a positive number in the dungeon, in Room 3 the number becomes negative! Most of you took this in your stride and came up with a final answer of 10836728, but I also accepted entries from Confused of Milton Keynes and others who turned the number into zero at this stage or used the BASIC ABS(x) statement.

October issue

Owing to a last-minute garbled phone conversation between the editor and myself, this competition became a nightmare and I became barmy myself! I apologise deeply to the two readers who approached me at the *Acorn User* exhibition to ask me if I was sure the whole thing was OK and I swore blindly that it was, without having checked . . .

The chief gremlins were that in problem 4 1.6 million should have read 16 million and that a key paragraph about what you were supposed to do with your starting



number disappeared (this level of the dungeon wasn't called the asylum level for nothing!). Most of you recognised the misprint for what it was but I also had to accept entries from people who assumed that the Tardis coordinates were factors of 2.6 million – and that in turn leads to several different solutions! In fact, so many different answers were received for this competition that I ended up including every entry for the draw where I couldn't spot a definite mistake on the part of the entrant. The answers were:

Puzzle 1: 88
Puzzle 2: 196
Puzzle 3: 160,225
Puzzle 4: 303

Room 0: He's a sensible dwarf
Room 1: He's a barmy troll
Room 2: He's barmy
Room 3: He's a dwarf
Room 4: You can't tell
Room 5: He's sensible
Room 6: He's a sensible dwarf

A lot of people went wrong in Room 6. Since you are told that you know instantly what type he is, you have to assume that the answer to the question, 'Are you an insane troll?" was 'No', which only a sensible dwarf would say – all the other characters would reply 'Yes'.

November issue

The combination number in the MD's fridge is 698,896. In Hermann's hideout the dwarf gold is in the first safe and the right number is 30,233,088.

In Christopher's corner, the number base is 89^2. The misprint here (the last three numbers here should have been 023 instead of 201) at least didn't fool any of you! The dwarf gold is in the first safe.

In Laurie's lair the right number is 1764 and the dwarf gold is in the first safe.

In Andy's attic the dwarf gold is in the first safe. There are four solutions to the problem, but only one of them – 60984*57321 – fits the bill for the final answer as described.

In David's dug-out the first safe contains the dwarf gold. Therefore you end up giving Mad Alex 1,280 gold pieces and the sum of the combinations is 31059974.

I should have realised, of course, that inviting *Acorn User* readers to spot anomalies was like offering Christians to starving lions.

The one I wanted, which many of you realised, was that since there is no indication that Mad Alex is a dwarf, why on earth should you believe a word he says? A lot of you are evidently experts on the breeding habits of dwarves and trolls and found it quite impossible to understand how the Master Dwarf and Master Troll could have been brothers. Others cast aspersions on my own parentage.

One or two people who know Mad Alex personally pointed out that he's far too impolite (putting it mildly) to show people round a dungeon. I prefer to think he's too busy answering the phone and helping the customers he loves so much with their queries . . . Best of all was Mrs Turner of Aberdeen, who wondered what had happened to the female dungeon-dwellers needed to produce the dwarflets. And Mrs Gatrell of Poole, who obviously works for Mrs Thatcher, wrote, 'The descendants must have been lazy toads, making barely more gold in a few hundred years than the masters did by the time the Master Dwarf was 42.'

Congratulations to all of you who

entered. I only wish you could all win prizes for the suffering and devotion you showed.

TWO-PART PUZZLE

AS regular readers know, normal currency in the dungeon consists of the very sensible £ s. d. system. However, Mad Alex is chairman of the *Acorn User* Dungeon Currency Reform Society, which believes very much in decimalisation – and a few other things. In Mad Alex's system the money is based on a quinn: it consists of 100 addisons (the lowest unit of currency) and includes a telford (worth 25 addisons) and a curry (worth 5 addisons). Mad Alex is keen to introduce a coin called the kitty.

Indeed, when I last discoursed with him, in between quaffing wellingtons full of bulls' blood, he told me that the kitty would be 'where it's all at when the system comes on line. You could make a few k handling the advertising rights, no sweat guv.' He went on enthusiastically, 'You name me another coin which could form the sum of 100 quinns in precisely 14 different ways (always assuming at least 1 telford and 1 kitty were included in the arrangement).

Does the kitty work? What are the highest and lowest amounts it could be worth?

I still don't know whether Mad Alex is a dwarf (ie, one who speaks the truth) or a troll (one who always lies). Perhaps our competition fans could enlighten me.

AFTER a hectic Christmas party at his computer club a fan gave a somewhat rambling account of the goings-on. 'We elected four new members on to the committee – Anthony, Bartholomew, Christopher and David. All I remember is that one was a machine-code programmer, one a hardware expert, one a designer and one a graphics consultant. For the life of me I can't remember which was which.

'I recall that the hardware expert isn't Bartholomew. Oh yes, David is the machine-code programmer if Bartholomew is the designer but he's the graphics consultant if Anthony's the hardware expert. Bartholomew isn't the graphics consultant unless David is the machine-code programmer, but he must be the designer if Christopher is the graphics consultant. And, of course, David is the hardware expert, unless either Bartholomew is the designer or Christopher is the machine-code programmer. Oh, I give up.'

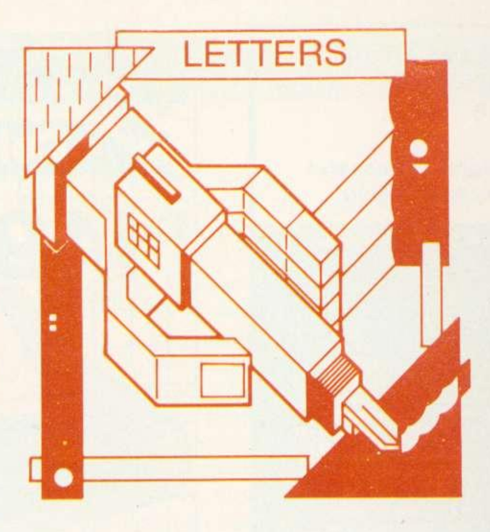
Can you work out who does what?

Answers, on a postcard please, should be sent to March Competition, *Acorn User*, 53 Bedford Square, London WC1B 3DZ to arrive not later than April 6, 1984. There will be three prizes of Acornsoft software to the value of £20 – say whether you want cassettes or disc – for the first three correct solutions to be picked out of the hat.

October winner was R Collier of Hassocks, Sussex, who receives the second Seikosha printer (donated by Microage Electronics) for his succinct and cynical postcard. Runners-up were Richard Lee of Reading and Arne Angelsen of Oslo (liked the icy view of the harbour!).

November winner was P A Davies of Derby who, although he confessed himself 'not too sure', got it correct right down the line. He wins Seikosha printer number three, courtesy Microage. Runners-up: O J May of London (who is convinced Mad Alex is 'the epitome of honesty'); and A R Thomas of Hinckley.

An honourable mention for Frank Dashwood of Edinburgh for the most amusing correspondence. He re-captioned his card illustrating a 16th-century terracotta bust as 'head of a worrier'.



ACCOUNTING FOR TAPE PIRACY

Sir, While reading the letters page in your February issue I noticed a letter on tape piracy and the general unhappy state of software houses and customers. While I agree with Mr Rutgers on most of the points he raises, I feel that a stronger attack is required on what is at present sheer exploitation by those producing software.

My two main interests are home computing and record collecting, and there are many connections between the two. Over the past five years the software market has boomed, to the extent that charts for this are now as commonplace as charts of single records, but it is noticeable that where piracy of computer games tapes is a major problem, the same does not apply to these records. (Most record piracy is in the form of album copying.)

The reason for this is obvious: the price of a single is approximately £1.50, whereas the price of a tape can be anything from £7 to £15, or more for an educational or business tape. The market for games is mainly a schoolboy/girl area, where money for software is obviously limited to around £5 a week. In other words even children with the most money can only afford to buy a tape fortnightly, if, that is, they buy the manufacturer's copy. A blank tape, however, costs only 50p, and so there are not many people willing to pay the extra £9.50 for a brightly coloured index card, when they can easily obtain a copy of the game from a friend for this total charge of 50p.

About a year ago, research showed that only one copy in 30 of Acornsoft's *Snapper* was genuine, a fact which no doubt holds true for all well-known programs today. It seems, however, that software houses have missed the only real solution to their problem. Instead of attempting to build in all types of protection barriers (which are easily overcome by anyone with a dual cassette deck) they should reduce dramatically the price of the software to a more affordable level, say £1.50 to £2.

Based on assumed figures, I estimate the cost of producing a program tape as £1, leaving £9 profit on a present cost of £10. Now if the cost was £1.75 and half of our 30 illegal copiers bought it, the profit would be 15 times 75p or £11.25. Hence an increased profit to software houses of £2.25.

The reduced price would make the genuine tapes more affordable, and more people would be willing to pay the extra for packaging and instructions. Then, there's the peace of mind in no longer breaking the law.

If you were, for instance, to reduce the prices of your own tapes by around £6, then I can assure you that within a few months you would be at the top of your own software chart. All it really requires is a large manufacturer such as Acornsoft or Program Power to take the lead and the others would have to follow. Then the producers and the consumers might both get what they want. **David Rogge**
Ayrshire

While we're not going to say consumers are not exploited (because several reviewers have said as much, anyway), you're hardly being fair on software houses.

First, why don't you compare album tapes to software tapes? Is the work and talent involved in producing a six-minute program less than for a three-minute single? And why do you think singles are not produced on cassette tapes?

Then there are your costings. What happens to the software dealer's profit (anything up to 50 per cent of the sale price)? The poor author (20 per cent seems a common royalty)? The staff of the software house, advertising, promotion, VAT, and the rest of the overheads – where are they in your figures?

If anyone was going to follow your 'sell 'em cheap and fast' philosophy, you would have thought Virgin would be the ones – but they can only match our price. Then there's *The Hobbit* – possibly the biggest selling game ever—and that still costs £14.95.

So at the moment it still seems to be a case of charging what the market can stand – and you will notice Sinclair software is cheaper than BBC software (but then it sells in much greater numbers).

PIRATES' MEDICINE

Sir, Ever increasing software piracy leads me to ponder whether copyright laws should or should not apply.

The author of a novel, perhaps equivalent to many hundreds of 'k' of information, will have spent months on it. This is poorly rewarded with low book prices and high publication costs. Similarly, composers are faced with limited distribution as well as the above costs.

The production costs of the average piece of computer software is certainly not above 50p and the marketing costs cannot add to this substantially. With games costing around £8.50 this leaves large profits to the software company. These companies are now trying to hide behind legal protection designed to prevent authors and composers living below the bread line.

Perhaps software companies should examine their own style of piracy first. Indeed, lower software prices may greatly reduce other forms of 'piracy'. **Adrian Loening**
Coventry

RETIRED VETERAN

Sir, I wish to inform you that my highest score on Acornsoft's *Planetoid* is 503,300. I obtained this some time ago, but as I am now into machine code programming and computer electronics, I long ago ceased to exhaust myself on playing games.

By the way, *Planetoid* was the first and the only action game I've bought. I found my initial investment of £10 has been truly worthwhile. **Kai**
Rotherham

GETTING ON IN LIFE

Sir, I found 'Life Variations' (January issue) most interesting and surprising (particularly as you got programs 2 and 3 transposed).

What was even more surprising was that program 4 failed to work as expected. Apart from nine squares in the centre of the screen and the 'generation' ticking away quietly in the top left-hand corner, nothing else happened. Whenever I asked P% where it had got to, it always returned −1 which was, presumably, why nothing was happening.

However, when I added line 175PLOT 69,x%,y% it revealed that the scan was taking place where it ought to be and P% returned values between 0 and 3. With the extra line deleted I was back to the original situation.

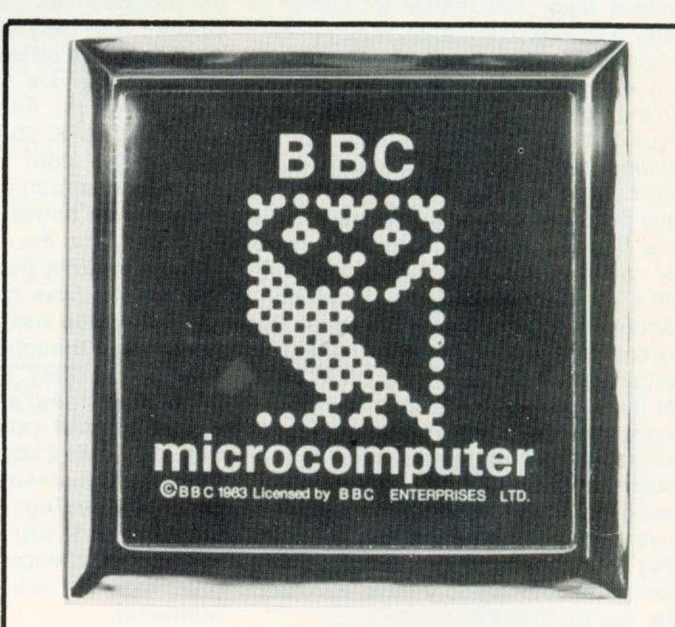
I then had access to another computer and program 4 worked perfectly. The only difference being that my machine had OS0.1 and the other OS1.2. I now have OS1.2 fitted and the program works fine.

I don't understand what the bug is since POINT(X,Y) has worked on other programs. However, I trust this tip may be of some comfort to other readers who may be as frustrated as I was. **J Bulmer**
Newport

You're right all the way, but POINT isn't the problem. However, PLOT81 is, as it isn't available in OS0.1 (line 100). Rest assured our programs editor has had his wrists slapped.



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BBC Cable. 26-7203 .... £39.95
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ACCENT PRINTING

Sir, I was interested to see the article by Simon Berry in November's *Acorn User* on Spanish accents. I have written a large number of German language programs and use CHR$128 to CHR$135 in a similar way to define characters such as Ä, ä, Ö, ö, Ü, ü, β and é.

I have an Epson FX80 printer and Juki 6100 daisywheel. Unfortunately, whenever listings containing these redefined characters are transferred to the printer the characters are ignored and any work containing one of these characters appears to be incomplete.

However, if it is essential to have the characters printed it should be quite possible on the Epson FX80 to select the German character set which uses CHR$91 92 93 123 124 125 and 126 to print all of the above except é. This would mean having to redefine the following keys on the keyboard ˆ / [{[}, most of which are rarely used for any form of foreign language program.

Alternatively, it would be possible to use the Epson's ability to download user-defined characters, in which case CHR$128 to 135 would be printed as per normal.

When printing letters, worksheets or other documents using Wordwise on the Juki printer, ESCJ will print an umlaut. However, this needs to be preceded by a backspace to position the umlaut over the appropriate letter. The sequence can easily be incorporated into a function key and printed pressing CTRL+SHIFT +function key.

Graham Sims
Yarm School
Cleveland

BASIC POINTER

Sir, Your January edition is even more thought-provoking than usual: a very good issue. Thank you. May I make comments on three items?

Ian Birnbaum's summary of where to locate machine code is useful, but he should make it clear that the pointer 0%, accessible using OPT4 to OPT7, is not available in Basic I. Incidentally, my local Acorn dealer refuses to admit that there are two versions of Basic and says it is not possible to supply the later version. The only answer seems to be to make an illegal copy into EPROM! How about putting some pressure on Acorn to reverse this stupid policy?

Second, I have a program which automates the copying of discs to tape as requested by Mr Malcolm Andrews. As he says, it is necessary to *LOAD and *SAVE, but this works perfectly well with Basic so there is no problem. The only trick is to eliminate the need to do RECORD and RETURN manually during the cassette saving. Readers may be unaware that turning off the screen messages with *OPT1,0 also turns off the requirement to insert a <CR> into the sequence and the bleep (VDU7) at the end of the save. I have not seen this documented anywhere!

Finally, may I echo Mr William Smith's plea for a compilation of any additional OSWORD calls; only &7F is mentioned in my copy of Acorn's DFS manual. There are a few new OSBYTE calls about too, eg with A%=&6F mentioned by Mr Pendleton in the December issue in connection with his most valuable dual-catalogue program (to read the last-accessed drive). Neither the *User Guide* nor the *Advanced User Guide* mentions this: are there any more?

I do quite enjoy the sense of discovery that is ever uppermost with the Beeb, but there are quite enough adventure games around without Acorn's attempts to turn the operating system into one!

Brian Carroll
Aldershot

Our apologies for not making the point about Basic clear in Ian's article. This was in fact the final part of a three-article series on the new facilities of Basic II.

George Hill's routine for disc to tape transfer is underway, and comments would, as on all matters, be appreciated.

As for Basic II, Acorn 'has every intention' to make it available to the public, and the larger dealers should be receiving stocks. However, supplies are being eaten up by new machines.

DOUBLE DUTCH

Sir, The following matters have been of concern to our club, and could, we feel, be of interest to others.

First, is saving a section of memory. This is explained in the *User Guide* (page 392). Only three addresses are mentioned (start, end, execution) but it is possible to include a fourth one, the reload address. It is optional, as is the execution address. If left out, they both default to the start address.

A rather misleading comment seems to be made in the *User Guide*, page 330, when explaining the PTR statement: 'Files are opened with the OPENIN and OPENOUT statements'. This comes after confirming the need to open a file on the selected channel before the PTR# can be used.

Although OPENOUT has to be used for 'creating' such a file, we had great difficulties in finding out what was wrong in a random access file program, which included OPENOUT for writing and OPENIN for reading, as mentioned above. The program actually deleted part of the file and made it shorter. The problem was cured by using only OPENIN for both reading from and writing to the file. We have, therefore, come to the conclusion that OPENOUT cannot be used to open a random access file.

Thirdly, one of our members, with a tendency to experiment on the forbidden side of science, ie to do what he is supposed not to do, discovered he could format with 80 tracks his discs (certified for only 40 tracks) in his 100k drive. Programs and files were normally admitted and when compacted, the number of bytes left free gave the impression that he had found an easy way to have double capacity at the price of single side, single density. His 'discovery' was most welcome, but when thoroughly checked it was found that his drive could not go beyond the 100k limit.

Now to a question. Two big UK retailers have announced 'true' double density controller boards. They mean 20 sectors per track instead of the present 10 sectors. It is also said that Acorn's 8271 disc controller chip cannot support double density. *Who is right?*

I Beng
BBC Micro Club
Santa Cruz de Tenerife (Spain)

The three points you make are valid and worth repeating. OPENOUT is only for opening a *new output* file.

Now down to your question. In fact both parties are 'right'. The 8271 will not support double density. However, this is got round by supplying add-on boards with the controllers, thus by-passing the 8271.

TEMPTING TAPES

Sir, I own an Acorn Atom, and as you will know it is very difficult getting hold of software. Are the copyright laws on tapes which companies no longer produce still in effect, or is it now possible to copy these tapes?

A Conner
Southampton

The copyright laws definitely still apply to software which is out of print. What you have to do is to write to the company concerned and ask if you can copy the tape. Boring, but it's the only legal way.

Note that one of our authors, Barry Pickles, is trying to start up an Atom library by buying the copyright on old programs. At least something is happening.

KEY TO LOCK

Sir, How can one lock programs so that they cannot be copied from the original? I am losing business drastically because of people distributing copies of my copyright software without paying royalties.

Richard Bhanap
Birmingham

See the articles on program protection in the February issue, page 49; January, page 69; December, page 81. These and other ideas over the past year, mainly in Beeb Forum, give several techniques, which, of course, are best used in combination, or with some variation.

GIRLS AND BOYS

Sir, I unfortunately missed the article: 'Why the girls don't compute', but did read Carina Moss's letter (December 83). As a male computer freak who also does some youth work, may I make a few observations?

I have taken a computer to youth clubs many times and have found girls and boys equally interested. Senior youth club attendance is numerically biased towards males so it's difficult to give numbers. However, among the seven to 10-year-olds, interest is about equally divided.

These are not hobbyists, nor am I talking about individuals familiar with computers. Most have only had brief contact with computers at school, or none at all. When confronted with a computer, most expect to play games, and it is quite difficult to get them to try programming. However, when I succeed, and we write (usually) little 10-line Basic routines, both boys and girls seem keen to have a go.

The interest and enthusiasm is there. Perhaps it's the encouragement that the girls are lacking. After all, how many boys woke up to a computer in their stocking at Christmas? And how many girls?

G Sargent
Loughborough

BLISS PLEA

Sir, Could I appeal through your columns for any information available relating to Bliss Symbolics and the BBC micro? I have a son of 4½ years of age, above average intelligence, who is unable to talk and any such assistance would give him a unique opportunity to express himself.

I would be grateful if you could pass on any replies to me.

A Morgan
Milton Keynes

CARIBBEAN CLUB

Sir, This may be a long shot, but I wonder if anybody in the Caribbean would be interested in forming a BBC micro group? It would probably have to be a postal one, but if there are other BBC owners in the West Indies I would like to hear from them. My home phone number is Montserrat 5674. There are presently two BBC micro owners in Montserrat, both using British (not US) models.

I have noticed a number of letters in magazines from people who wish to use a British BBC micro in countries which do not use the British standard 625-line PAL UHF TV system (eg in the US). The British BBC will not work with a different TV system. One solution is to buy the US model of the BBC micro, but it is more expensive and it has a different operating system so software is not compatible with the British model.

Another solution might have been to buy one of the multistandard PAL/NTSC colour TVs, but the output from the BBC is insufficient to drive such TVs correctly – as I found to my cost. A good colour picture cannot be obtained from the micro by this system (cf your reply to Nigel Webley's letter in the January 1984 issue). The only real way out is to use a proper PAL colour monitor!

I also note tales of woe from foreign Beeb owners (or would-be owners) about the lack of co-operation from British equipment suppliers. Every British supplier who I have ordered BBC-related items from has given fast and problem-free service, so I would not like potential customers to be put off.

Thanks for a most useful and enjoyable magazine!

Dr Tony Glaser
American University of the Caribbean
PO Box 400
Montserrat
West Indies

As far as we know, there is no general problem with PAL/NTSC colour TVs. It is true that the TV signal from the Beeb is, along with other micros (and video recorders), not up to broadcast standard, but that isn't a general problem.

However, some modern sets expect highly accurate, digital channel control which the Beeb cannot give. You might have one of these TVs.

Some TV sets can be adjusted, as can the Astec video modulator (the silver box in the corner of the Beeb's board behind the UHF plug). This might improve the picture, but get someone who knows something about it to do the adjusting.

We would be interested to hear from anyone who can throw light on this subject, or recommend a PAL/NTSC TV.

ATOM DUMP

Sir, I have an Atom, Wordpack and Epson MX70 printer. At first I had to be content with using the printer only for listings or with the Wordpack, as the manual was incomprehensible, and *Atomic Theory & Practice* has little to say about printers. I eventually worked out how to use the printer in text mode from the single example of how to enter control codes given in the Epson booklet.

I should now like to explore the 'bit image mode', but after entering the control codes I have no idea as to how to enter bit image data. My unsuccessful attempts confirm that after entering "ESC K" (P.$27$75) bit image mode is entered, but whatever I enter subsequently has no effect that I can make sense of. No clue is given in the booklet as to the form the data has to take, my supplier is not able, or is not willing, to give me advice, and a letter to Acornsoft drew a similar blank. Can you help? A simple illustrative program or two would be worth thousands of words – a point which seems to be lost on the writers of manuals.

I should like to support the views expressed by Andrew Ward in November's issue. For example, a few parallel listings in the series on printers might have made it accessible to Atom owners. The appearance of Atom Forum was most welcome – I was about to give up all hope of seeing articles of use to me – but it would be nice if the listings were more accurate.

R Stebbin
London

We tried to locate a screen dump for an MX70, but couldn't. Any readers who have a dump might like to send it in so we can pass it on. Otherwise, George Hill's article in June's issue should be of some help.

The escape code problem is within our grasp. What's happening is that 'ESC' is being sent to the processor, as well as the print channel. This means the program ends, as it would if the escape key were pressed.

There are two solutions. One is to poke the printer port with:

```
?#B801=27;WAIT;?#B801=75
```

The other is to temporarily alter the WRCHVEC to point to #FEFB. This sends all subsequent output to the printer only. The code for this is:

```
100 !#208=#FEFBFE94;REM:Alter
    vector
110 P.$27$75; REM ESC K
120 !#208=#FE52FE94;REM:Restore
    old vector
```

FITTING THE BILL

Sir, I am writing to ask for your assistance in locating a source for software covering the billing of hotel guests.

I have perused *Acorn User* without success in my search, and realise that this information must be somewhat specialised and out of the usual trend of software manufacturing.

The requirements are simply for the billing of a 12-roomed hotel plus the running of the restaurant charges. We are not looking for stock control or anything of that order.

Our equipment is a B model with a double disc drive and a Juki 6100 printer.

Any information your readers can supply will be gratefully received.

James Birnie
The Elms Country Hotel
Swains Road
Bembridge
Isle of Wight

APE ACE

Sir, In reply to J McDowall's letter in your December issue concerning a high-score record by his brother, I am proud to say I have recorded a high score of 100,400 in Program Power's *Killer Gorilla*.

Keep the great magazine going.

M MacAdam
Farnborough

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DO YOU want to swap BBC micro software? If so please contact Colin Pearse, 9 Ballachrink, Colby, Isle of Man. Preferably ring (0624) 83 3986.

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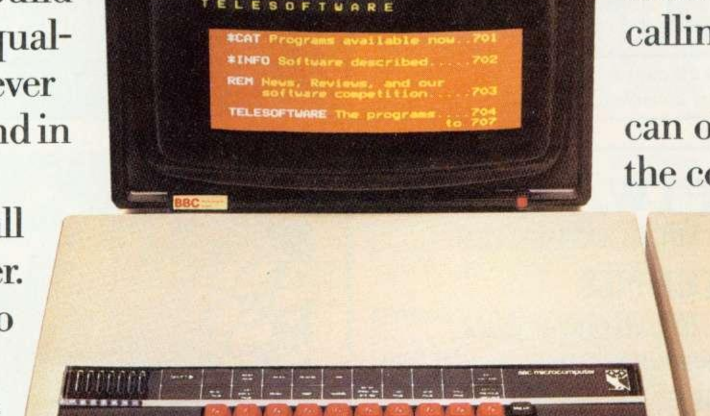
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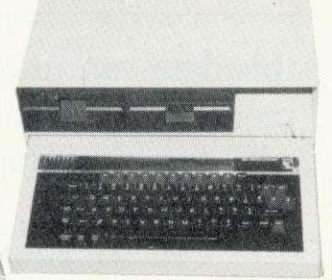
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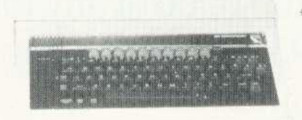
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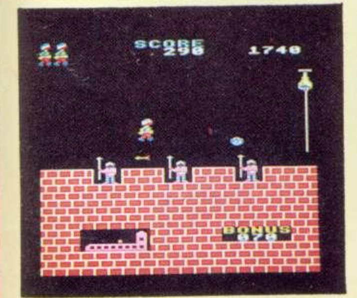
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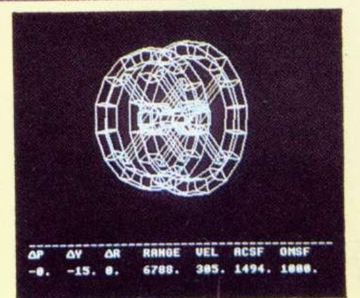




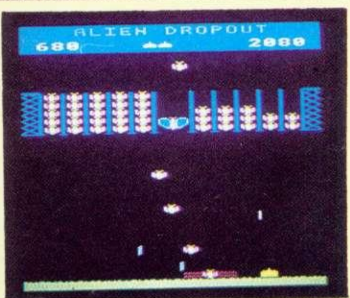
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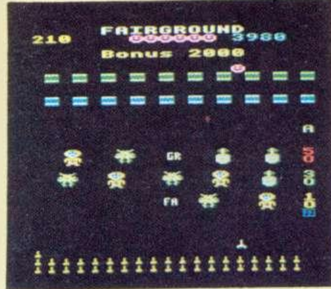
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